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ABSTRACT

The main purpose of the experiment was to answer the question whether broad or narrow terms function most effectively in the retrieval of relevant documents. The answer depends on what the user of the retrieval system wants, his wants being expressed in terms of stated precision-recall preference, or by the exact number of relevant documents he wishes to retrieve. Depth of indexing does not contribute significantly to effective retrieval. Documents should be indexed with broad terms to satisfy recall preferences with narrow terms to satisfy precision preferences since the amount of material retrieved in a system is not a simple function of the total numbers of terms posted to documents in the collection. At high cut-off values the retrieval power of broad and narrow terms tends to become equalized. Precision can be improved through raising the cut-off point and deleting broad terms. Experiments with weighted indexing provided poor results, and with title-term indexing gave inconclusive results. (AB)

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THE UNIVERSITY OF CHICAGO

THE EFFECT OF INDEXING SPECIFICITY ON RETRIEVAL PERFORMANCE ②

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CHAPTER I

THE MEANING OF SPECIFICITY

Introduction

The study undertaken here is in the area of indexing theory. The question to which the study is addressed is how specific should index terms be. So worded, the question poses difficulties. It is not clear,for instance, what is meant by "specificity." "How specific is specific?" is a question raised in the library literature whenever the "principle of specific entry" comes under discussion.

The specific entry principle is an injunction to catalogers to deal with language in a certain way -- to find the most specific subject heading for a work being indexed. It assumes that one can say in a reasonably simple way what a book or document is about -- specifically, where specifically is illustrated by reference to inclusive classes:

> Enter a work under its subject-heading, not under the heading of a class which includes that subject. Ex. Put Lady Cust's book on "The Cat" under CAT, not under ZOOLOGY or MAMMALS or DOMESTIC ANIMALS;[1]

The principle of specific entry is usually acknowledged as a tenet inviolable in the practice of assigning subject headings. Indeed it would seem that no other principle or rule of indexing[1] enjoys a similar stature. Yet it has been observed that the relativity of the principle makes it difficult to apply or comprehend. A problem then in the study under consideration is to find a way of coping with the apparent elusiveness of the concept of specificity. In particular what is needed is a definition of "specificity" which is clear and distinct, suitable for use as a variable in a theoretical or experiment study of indexing effectiveness. In order to give something more than a speculative discussion of specificity, a procedure must be found for objectively evaluating indexing at varying levels of specificity. Such a procedure must include a method for systematically varying the specificity of indexing. Also required is a method for measuring which of the "more or less" specific indexings is the most effective in retrieval performance, in the sense of enabling users to find all and only those documents relevant to their needs. These are among the matters discussed in the following pages which propose an approach toward the problem of evaluating specificity in indexing.

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[1] Charles A. Cutter. Rules for a Printed Dictionary Catalog (Washington, D.C.: U.S. Government Printing Office, 1876), p. 37.

There are four chapters. Chapter I discusses the background of the problem: the first appearance of a need for specific indexing in the nineteenth century and the consequent concern for specificity reflected in the development of subject and title catalogs. the continual confusion over the meaning of specificity, in particular the relativity of its meaning. Seven definitions of specificity are considered. One of these, called "operational specificity," is selected for use in an experimental study of indexing effectiveness. This definition is adequate in the sense that it gives a quantitative measure of the specificity of an indexed collection of documents and provides a method whereby the specificity of indexing can be varied in a systematic way. It is argued that this definition also reasonably explicates what is vaguely understood by "specificity" in the minds of those following the specific entry principle when assigning subject headings.

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[1] The viewpoint is taken that in the assigning of terms to books or documents there is no essential difference between subject cataloging, information indexing and classifying.

The core of the present study is an experiment designed to test whether specific indexing is better than non-specific or broad indexing. The experiment is a retrieval experiment; that is, documents are retrieved from an indexed collection of documents in response to search questions addressed to the collection. The output is then evaluated according to one of the usual measures of retrieval effectiveness. In the experiment the indexing of the document collection is altered by deleting sets of terms, broad terms and narrow terms. After each alteration in indexing, retrieval and evaluation procedures are carried out. Obtained thus are different measures of retrieval performance for indexings of varying specificities. The data used in the experiment is the Salton-Cranfield data, consisting of 200 documents in the field of aeronautics, 42 search questions addressable to the document collection and relevance judgments for each document with respect to each of the questions. Chapter II outlines the experimental design. Results are analyzed in Chapter III. Chapter IV summarizes the results and speculates on their practical applicability both within the constraints of traditional library operations and with regard to what may be possible in libraries of the future.

Background

The problem of specificity made its appearance in the library literature in the middle of the nineteenth century. At this time there was indication of a growing dissatisfaction with the classed or classified catalog. Quite apart from the view which regarded the classification of books as a "logical absurdity,"[1] retrieval difficulties were encountered on a practical level. Samsom Low, for instance, complained that

> under the old system of classification (the classified catalog) the difficulty has always been to find a given title, though enabled to find a group of books published within a scientific discipline.[2]

As a response to the difficulties it was proposed that books should be indexed according to the words in their titles. Crestadoro was the foremost proponent of title-term indexing. Proposing a concordance of titles which "follows out each author's own definition of his book,"[3] he put his principles into practice first in the

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[1] Jevon's famous remark. For an account of the theoretical opposition to classified catalogs see J. Metcalfe, Subject Classifying and Indexing of Libraries and Literature (New York: Scarecrow Press, 1959), p. 32 ff.

[2] Quoted in J. Metcalfe, Alphabetical Subject Indication of Information. Vol. III of Rutgers Series on Systems for the Intellectual Organization of Information, ed. Susan Artandi (New Brunswick, N.J.: Rutgers -- The State University, Graduate School of Library Service, 1965), p. 25.

[3] From his Manchester Catalogues. Quoted in J. Metcalfe, Information Indexing (New York: Scarecrow Press, 1957), p. 48.

British Catalog and then in the catalogs he prepared for the Manchester Public Free Libraries. Poole also advocated title-term indexing -- but with reservations:

> In most cases the author's own title best expresses the subject -- but if he has given it an obsolete or fanciful title, the indexer will give it a better one, and will place it under the heading where it naturally belongs.[1]

The import of the reference is clear. It is necessary that if some sort of rapport is to be established between the catalog and the catalog user, the catalog must use a language relatively free of surprises, one that is at least somewhat predictable. Crestadoro himself was quite aware of the weakness of title-term indexing and he warned the users of his catalog that some relevant items would be missed: "under any given subject the whole of the books . . . are not brought together, but only those in which the name of the subject occurs in the title."[2] The arguments for a uniform language and for completeness led to the development of the alphabetical subject catalog -- a catalog of standard subject headings alphabetically arranged. While dealing a "death blow"[3] to title-term indexing was a purpose in the creation of the alphabetical subject catalog, it was, however, subordinate to the more important purpose of providing a viable and constructive alternative to the classified catalog. The classified catalog, by permitting generic entry only, made it difficult to find books on a specific subject. It was this lack of specificity that the alphabetical subject catalog was intended to remedy. The Principle of Specific Entry was stated by Cutter in 1876: "Enter a work under its subject heading, not under the heading of a class which includes that subject."[1] And in 1951 the raison d'etre of the subject catalog seems virtually unchanged: "The primary purpose of the subject catalog is to show which books on a specific subject the library possesses."[2] Somewhat regrettably perhaps, for it obscured the issues, the opposition of specific vs. generic entry continued to be regarded as part of the controversy over the relative merits of the two kinds of catalogs. The controversy goes on still today, though with diminishing force, especially in America where the alphabetical subject catalog is well entrenched in most libraries and the principle of specific entry is, in practice at least, everywhere accepted.

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[1] Quoted in Metcalfe, Alphabetical Subject Indication of Information, p. 27.

[2] Quoted in Metcalfe, Information Indexing, p. 48.

[3] Metcalfe in Information Indexing quotes Taylor as telling British students that "as far as British and American cataloguers are concerned, its (title-term entry) death blow was dealt by Cutter," p. 47.

The Problem: Relativity of Specificity

Confusion has centered around the specific entry principle from the time it was first formulated at the end of the last century. A recent expression of the confusion is Dunkin's complaint, made in the summer of 1967:

> 'Specificity' is a magic word which we all accept but seldom really define. 'Specificity' means all things to all men and little to most, particularly when we are prepared to abandon our

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[1] Cutter, Rules for a Printed Dictionary Catalog, p. 37.

[2] David J. Haykin, Subject Headings: A Practical Guide (Washington, D.C.: U.S. Government Printing Office, 1951), p. 1.

> definition at any point where the 'convenience of the public' can be argued.[1]

The question "how specific is specific?" is a recurrent one in the literature of library science. Often it is simply asked rhetorically for the purpose of showing that there exists a problem of viewpoint:

> How specific is specific entry? As shown, Cutter was specific when he used Shetland wool and Merino sheep, Framework knitters, Handloom weaver, and Pneumatic loom. But . . . Cutter was living in simpler times. Would he have been as specific as a model of a make of motor car for the model's manual; for example, the manual of the Morris Mini Motor Car?[2]

Perhaps the most direct assault on the relativity of "specificity" was that made by O.L. Lilley in 1955. He answered the question "How specific is 'specific'?" with "Well, it all depends!"[3]

Constructive answers to the question generally refer to a "public." Cutter, for instance, demanded that the specific entry principle be viewed in light of another principle, viz. the usage principle which requires that headings be chosen from the language of a particular public, the public for whom the catalog is intended, rather than from the indexer's own language or even that of the document. Metcalfe argued that, in practice, subject headings are not always as specific as the subject of the work and that one of the reasons for this is that the catalog user must get what he wants by a name which he knows, without any guesswork on his part.[1] It is rather the indexer's obligation to guess at the degree of subject specification which will best serve his public. The public is the operative factor.

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[1] Paul S. Dunkin, "Cataloging and CCS: 1957-1966," Library Resources and Technical Services, II (Summer 1967), 284.

[2] J. Metcalfe, Alphabetical Subject Indication of Information, p. 35.

[3] Oliver L. Lilley, "How Specific is 'Specific'? " Journal of Cataloging and Classification, II (January 1955), 8.

It is not immediately clear what good can be accomplished by introducing a public. It is doubtful, for instance, that a cataloger instructed to index a document as specifically as possible from the point of view of the public served is likely to have appreciably better insight into what he is doing than were he told simply to index with specific terms. Findings of a consensus set study conducted as part of an Indexing Project at the Graduate Library School suggest that while indexers agree on the important concepts to index, they alter these in various ways when verbalizing them into index terms, and that one of the most usual alterations is changing the level of specificity.[2] And again, in another study on the Indexing Project, it was found that disagreement about the choice of index terms is, in large part, attributable to a difference of opinion as to the appropriate length of phrase to be taken as an index term, again suggesting that much of the inconsistency among indexers is due to disagreement about degree of subject specification.[3] If on the appropriate degree of subject specification, coincidence of point of view is rare among indexers describing the same document -- one wonders how much rarer still it must be between an indexer and a public who might find the document useful? After all, a public is single only when regarded as a vague undifferentiated mass; scrutinized more closely it appears fragmented into as many different points of view as there are individuals making up the public. Seen this way, one may agree with Lilley that "specificity may be so intangible as to be nothing more in an effective sense, than a chance relationship between the user's need of the moment and the format of a particular book an individual library happens to own."[1] Coming back to the question: how specific is specific? -- invoking a "public" would seem not to provide hope of a useful answer. It shows specificity to be entirely viewpoint dependent.

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[1] J. Metcalfe, Subject Classifying (New York: Scarecrow Press, 1959), p. 51.

[2] W. Boyd Rayward and Elaine Svenonius, "Consistency, Consensus Sets and Random Deletion," Studies in Indexing Depth and Retrieval Effectiveness (NSF GN 380) (Chicago: University of Chicago, Graduate Library School, 1967), p. 3.

[3] *Ibid.*, p. 1.

Questions of viewpoint are very like questions of relevance; both attest to the rights of individual imagination, and both work against the exploitation of language for the purpose of retrieving information. The position outlined above, which is ready to reject the concept of specificity because it is so much a matter of viewpoint,has a semantic parallel in a definite and rather extreme attitude towards language in general. According to this view the meaning of a word is a variable; it varies according to context. Some meanings are more stable than other, for instance those of technical terms, but even these are subject to flux, shaped by the meanings of contiguous words on the written page as well as by the net of associations elicited in the mind of an individual reader. Meaning is itself viewpoint dependent; so much so that it has been argued that no two uses of a word are quite the same, each use is a special case of meaning, there being no single meaning which is fixed and inviolate.[1]

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[1] Lilley, "How Specific Is 'Specific'? " p. 6.

The problem with specificity is in fact a problem in semantics, since specificity is a property of meaning. One word differs in specificity from another -- it is a rough way of saying that there is a difference in specificity of meaning. It is hardly surprising that specificity of meaning should be viewpoint dependent, when meaning itself is. Both vary according to context and individual mind-sets or dispositions towards the use of language. Lilley gives an example where the word Botany is specific in the context of departmental budgets, but general in the context of a group of botanists:

> Within the subject area of departmental budgets . . . the words "Botany" and "Geology" reasonably can be called specific terms . . . But in a group of botanists, if one individual were to remark that his special interest is "Botany", the statement would be so imprecise as to lack meaning for his hearers. In this instance "Botany" is no longer a specific term, but has become a very general one.[2]

Focusing on the relativity of specificity then may be regarded as a particular expression of a more general view of language. Carrying this view to an extreme, to a reductio ad absurdum, one can develop an argument for silence. Frege suggests that a word with vague boundaries cannot be called a word at all.[1] Rejecting so much rather commits one to semantic solipsism . . . as perhaps skepticism is the "price" of a too intense demand for certain knowledge.

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[1] Ludwig Wittgenstein, Philosophical Investigations, trans. G.E.M. Anscombe (New York: Macmillan, 1953), see esp. p. 66.

[2] Lilley, "How Specific Is 'Specific'? " p. 4.

> 'But is a blurred concept a concept at all?'--Is an indistinct photograph a picture of a person at all? Is it even always an advantage to replace an indistinct picture by a sharp one? Isn't the indistinct one often exactly what we need?[2]
>
> Wittgenstein, Philosophical Investigations

The main argument against semantic solipsism is that confusion and silence do not in fact represent what is generally the case. Language works in a dynamic way and words to be flexible enough for every occasion of their use must be somewhat vague and ambiguous. While this contributes to making language at some very basic level essentially private, it does not make communication impossible. A point to be noted in this connection is that it is possible for a word to be ambiguous in a very clear way. For instance pointer words such as "this" and "that" are extremely ambiguous, technically speaking, in that their possible referents are so extremely multiple; yet these words are generally used in such a way that their meaning is clear. There are really many situations where a "relative" word is needed. The meanings of words are stable as well as variable; it is a matter of degree. Meanings acquire a certain fixity inasmuch as they are used in accordance with linguistic habits or conventions. Wittgenstein likens these conventions and habits to rules of a game. There are really many language games, and their rules, more or less acknowledged, have the effect of forcing a degree of standardization more or less sufficient for communication and understanding. The notion of consensus is important here -- appealing to a consensus in the use of words to justify the possibility of communication, and in particular the retrieval of information. It is possible then, without denying the variability and conflict of viewpoints, to ask what is the nature and extent of the overlapping area of agreement about the specificity of index terms. Proof that there is some area of agreement is given in the Consensus Set Study mentioned on page 8.[1]

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[1] See quoted in Wittgenstein, Philosophical Investigations, p. 34.

[2] Wittgenstein, Philosophical Investigations, p. 34.

Another argument for not rejecting "specificity" on the grounds that it means different things to different people is that it may very well be a useful concept. Wittgenstein: "I use the name 'N' (substitute 'specificity') without a fixed meaning. (But that detracts as little from its usefulness, as it detracts from that of a table that it stands on three legs instead of four and so sometimes wobbles.")[2] This suggests an answer to the question: why, if no one seems to know what is meant by "specific," is the principle of specific entry so generally accepted? The answer here is a pragmatic one. Librarians have found the concept of specificity, as it is embodied in the specific entry principle, a useful one. It has served some purpose:

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[1] Rayward and Svenonius, "Consistency, Consensus Sets and Random Deletion."

[2] Wittgenstein, Philosophical Investigations, p. 37.

> We librarians take no little pride in the fact that entries in our subject card catalogs are made under "specific" headings. This doctrine of specificity we tell ourselves (and others), not only simplifies our own task of putting information into the catalog, but in turn simplifies the user's job of getting the information out again;[1]

Lilley goes on to suggest that librarians in their pride are guilty of self-deception since the word "specific" has no fixed meaning. The answer to that is: nevertheless, the meaning may be as precise as it needs to be. The fact that the doctrine of specificity is so widely accepted strongly suggests that it "works." The argument of pragmatism is, like the argument of consensus, a rather standard ploy in staving off the skepticism entailed in a position of epistemological relativity. With "specificity" it is a question of linguistic relativity.

The Uses of Specificity

The worry about specificity in library literature arises in part from the fact that the specific entry principle seems to be regarded as useful. Arguments for the usefulness of the principle are principally of three kinds. The first holds that subject headings should be specific because the demand of users is for specific and detailed information. The second is that it serves as a decision-making device -- if the most specific heading is not assigned, then where among the lattice-like branchings of possible subject headings is the "best" one to be found? Thirdly, choosing specific subject headings is a way of insuring that too many entries do not accumulate under any one heading, a situation to be avoided because it would make searching tedious. These arguments are considered below.

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[1] Lilley, "How Specific Is 'Specific'?," p. 3.

Julia Pettee writes that the increasing specialization of civilization has created the need for specific and detailed information:

> it (our present dictionary catalog) arose in response to a demand of our highly specialized civilization for specific and detailed information. To gain this information from treatises or through some classified system is more laborious and time consuming than by means of alphabetical captions to which one can go directly without an intermediary symbol. Hence Cutter's primary rule for the dictionary catalog 'Enter under specific topic'.[1]

The same argument, that the public wants specific as opposed to "classified" information, is given by Metcalfe:

> This reaches down to the basic reason for Cutter's alphabetico-specific entry; the catalogue user must get to what he wants by a name of his subject which he knows, in an order which he knows, without any guesswork classification on his part.[2]

Whether or not the demand for specific information is real or by intuition only assumed, is still, as it has been for more than half a century, a matter of speculation and opinion. It is true there have been many statistical studies of users' needs, but these tend to be unsatisfactory because of defects in methodology and in the analysis of results and because of questionable starting assumptions.[1] Most of these studies seem aimed at trying to find out whether the subject catalog is a useful device for finding information. The subject catalog, since it was developed in opposition to the classified catalog[2] and is based on the principle of specific entry, should, if Pettee's reasoning is valid, be useful to seekers of special and detailed information. The results of the studies, however, though admittedly tenuous, seem to indicate that no one would be greatly inconvenienced if the subject catalog were abandoned, at least in academic libraries: reference librarians rely mostly on reference works; research workers turn to subject bibliographies; and scientists have methods of their own.[3] Taking seriously these findings, one is led to wonder if perhaps this product, the subject catalog, that librarians are offering is not what it might be. In asking what might be wrong, the thought occurs that perhaps the principle of specific entry itself has in some way contributed to the catalog's failure to be relevant. By precluding broad subject headings when a specific one can be found, the principle has the effect of limiting access to the catalog. Broad terms may be useful. While a broad heading may fail to give a satisfactory description of a document, such a heading might, by its ubiquity, be reinforced in the memory of a user, and consequently be just the one he would choose to look under. A word often seen can be readily remembered, there being no need for guess work or imagination. Further, the more specific the headings the less chance there is of the user finding all the material he needs under a given heading. For instance, a library may have no or a too brief account of the history of Virginia. However, a good deal on the history of Virginia will be found in histories of settlements in Eastern States. Thus even when the demand is for specific and detailed information, it could follow that this demand is more often satisfied in a system which can permit the user to broaden a search in a meaningful way when he is not immediately satisfied by what the system yields under a specific heading. Pettee's argument seems weak. For subject cataloging and indexing in general, the question of whether broad or narrow terms are preferable seems independent of the "steadily increased demand for specific and detailed information."

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[1] Julia Pettee, Subject Headings: The History and Theory of the Alphabetical Subject Approach to Books (New York: H.W. Wilson, 1946), p. 57.

[2] Metcalfe, Subject Classifying, p. 51.

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[1] Carlyle J. Frarey, Subject Headings, Vol. 1, Part 2 of The State of the Library Art, ed. Ralph R. Shaw (New Brunswick, N.J.: Rutgers -- The State University, Graduate School of Library Service, 1960), p. 54.

[2] See pp. 4-6.

[3] Frarey, Subject Headings, p. 54.

The second argument for the need for a principle of specific entry is based on the usefulness of the principle in making decisions -- if not the most specific heading, what then. The possibilities are too many. Haykin uses this argument:

> It is necessary, however, to state the reason for the use of the most specific heading applicable, rather than the broader heading which comprehends it.
>
> If the subject catalog were to consist of a predetermined number of more or less broad headings, a work on a specific topic would have to be entered under the broader one. The broader heading would thus be used for works as comprehensive as the heading, as well as for works on all the topics comprehended by it. To find out whether the library possesses a book on a specific topic, the reader would, in the first place, need to know how broad a heading might be used for it, and, in the second place, would have to scan all the entries under the broader heading in order to select those

> which are of interest to him . . . a reader looking for material on the income tax can be sure of finding it quickly and surely only by looking under the heading Income Tax. If the library were to choose a broader heading, it would have to be Taxation or even Finance, Public. Obviously, the number of entries under either would be relatively large in any library. The reader could not, in any case, be certain that he had hit upon the heading which the library has, more or less arbitrarily, chosen for topics related to and including the income tax . . .[1]

This argument -- and Pettee's as well -- seems to be backed by the belief that a certain economy must be observed in the assigning of subject headings, viz., that the choice between a broad or specific heading must be an either-or-but-not-both option. The either-or assumption, however, cannot be immediately dismissed. For one thing, belief in it has been strong enough to energize the century-long controversy over the relative merits of the classified vs. the alphabetic subject catalog, the classified catalog providing for "generic" entry. Though from a logical point of view it is a misleading use of the concept of class, in the language of library literature "classified" is often regarded as "nonspecific." Cutter, for instance, in stating the specific entry principle uses "class" by way of a negative definition: "Enter a work under its subject-heading, not under the heading of a class which includes that subject."[2] The dichotomy is partly physical in that the arrangement of a catalog can be classified or alphabetical but not both. But partly also it is the dichotomy of whether a user wishes to find under a heading all or most documents relevant to his needs, at the expense of going through many irrelevant documents, or whether he would prefer to avoid examining a large number of irrelevant documents, but at the price of missing many of the possible relevant ones. This is the problem of whether it is better to maximize recall, the percentage of relevant documents retrieved, or to maximize precision, the percentage of retrieved documents which are relevant. A "tradeoff" seems to hold, for the most part: any improvement in recall results in a loss in precision, and, conversely, that a bettering of precision makes for poorer recall. The choice between all or only relevant material is not unrelated to the choice between broad or specific headings. Samsom Low's argument against the classified catalog, mentioned on page 4, seems to be an argument against access through broad terms and their potentiality for eliciting irrelevant material. The de facto as well as the theoretical history of library catalogs might be viewed as an attempt to reach some sort of acceptable compromise between broad and specific terms. Metcalfe points to "the steadily increased use of specific entry through the 19th and 20th centuries in the face of continuing propaganda for classified entry"[1] -- which perhaps suggests not compromise really, but a tendency to favor specific terms over broad ones, good precision over good recall.

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[1] Haykin, Subject Headings: A Practical Guide, pp. 9 and 10.

[2] Cutter, Rules for a Printed Dictionary Catalog, p. 37.

On the other hand, the generic-specific controversy and the either-or assumption on which it is based could be misleading. It is not clear why access through broad or specific terms should be thought to exclude each other. It seems natural to ask why not have both: why not let the indexer choose all possible terms which seem applicable, broad as well as specific, and let the user have the option of choosing the generic level at which he wishes to enter the system. The user would be well-served. He could, for instance, himself choose precision at the expense of recall, or vice versa, depending upon the specificity or size of his requirement. This is the question of "double entry," and in the literature there are arguments pro and con. On the pro side Pettee points out that Cutter's rule for "specific entry" does not forbid the practice of double entry. He says 'that if room can be spared, the cataloger may put what he pleases under an extensive subject (a class), provided he puts the less comprehensive works also under their respective specific headings.'[1] And then Pettee goes on to observe that this practice of double entry "arose in response to the demand for ready reference which is the major function of the small and medium sized public library." "There is no doubt," she adds, "that these libraries have been benefitted far more than they have been inconvenienced by this practice."[2] As reasons for not using double entry are cited the "cataloger's fallible judgment"[3] and the fact that the "inconsistencies of these duplicate entries have caused much confusion."[4] The inconsistencies and confusion presumably arise from the element of imagination which is introduced when catalogers are allowed to use subject headings more generic than the subject of the work being cataloged; the cataloger's imagination may lead to the user's bewilderment. But this argument is not very convincing if, as Cutter advises, broad headings are used only to supplement and not to replace the specific ones. Another, and seemingly stronger, argument against double entry is that the license it permits would burgeon the catalog with an unwieldy "reference apparatus," disproportionate to the number of actual items processed.[1] The danger of filling up the catalog is seen to be especially serious in the case of large research libraries. Pettee writes:

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[1] Metcalfe, Alphabetical Subject Indications of Information, p. 16.

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[1] Pettee, Subject Headings: The History and Theory of the Alphabetical Subject Approach to Books, p. 69.

[2] Ibid., p. 71.

[3] Ibid.

[4] Ibid.

> Certainly these duplicate entries should be carefully considered and watched, but it is only when the collections assume vast proportions and take on the major function of research that measures of more control and elimination become imperative.[2]

There is then some fear of losing control as the catalog increases in size and complexity. One might speculate that the fear need not necessarily be met by inhibiting the growth of the catalog. The possibilities offered by the computer might be seen as providing an alternative, in that the computer, as an organizing device, could make wieldy an elaborate reference apparatus far better than a physical collection of cards.[3] In particular there would be no need to choose either a classified or an alphabetical access method, since both would be possible. One entry only would be needed for each bibliographic item, and as many generic and specific added subject entries as needed could be provided in the form of an index. Moreover, were the new media to prove economically feasible as well, the rationalization that users demand specific and detailed information would become superfluous -- and also some users' studies -- since users could demand anything they wanted and be satisfied.

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[1] Frarey, Subject Headings, p. 59.

[2] Pettee, Subject Headings: The History and Theory of the Alphabetical Subject Approach to Books, p. 71.

[3] The statement needs qualification. Unconstrained by the conventional image of a card catalog, the mind can imagine an enormous reference apparatus structured in physical space in a way that would permit a staff of thousands to perform searches. Manual access, theoretically at least, need not be clumsy or tedious. Ultimately the choice between a computerized system and a manual one is a matter of cost.

The third reason given for the practice of specific entry is that it serves to break up a collection of books or documents into clumps of a reasonable size. This is perhaps the most important reason -- at least it has been impossible to discuss the other two reasons without sensing the existence of this one in the background. The reasoning is that there must be upper and lower limits to the number of books posted to any given heading. For instance, a user would not be happy consulting a heading such as History--U.S. if all books in the library on this subject, no matter how incidently or specifically "related," were collected under this heading. The heading does not have sufficient discriminating power and thus imposes on the would-be user the tedium of too much retrieval. That libraries are sensitive to the problem of over-retrieval is evidenced by the fact that where a very broad heading cannot be subdivided naturally, other devices, such as subdivision by publication date, have been suggested to control the number of postings to the heading.[1]

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[1] See Sidney L. Jackson, "Date Treatment of Broad Headings in Thirty Major Libraries: a Report with Comments," Journal of Cataloging and Classification, IX (March, 1953), 21-24.

On the other hand it can be argued that subject headings can be too special, scattering the collection so much that the organizing potential of subject indexing is unrealized. In the extreme and limiting case where each different book is assigned a different heading, the bibliographic situation is as disorderly as if no heading were assigned at all. The limits of specificity have been remarked by Pettee:

> The present tendency of the Library of Congress is to use very specific terms. As the choice between the most specific term (which can be used as a heading) and a more inclusive one depends entirely upon the number of items which will be likely to collect under the more inclusive term, a safe rule would be to prefer the more inclusive for less than a dozen titles which would be likely to collect under it. Collecting half a dozen books on trees of various kinds under the term Trees, serves the clientele of the very small library better than scattering them under Elm trees, Firs, Hard woods, etc. The larger collection will need the specific terms. The choice demands judgment on the part of the cataloger based upon actual knowledge of his particular readers' reactions to the catalog.[1] (my underlining)

Similar reservations about too much specificity have been made by Henry B. Van Hoesen[2] and by Haykin,[3] the point being there is a limit beyond which the number of books retrieved by any one heading cannot be sacrificed. It seems clear that an important function of the specific entry principle is to control what could be called the "operational breadth" of subject headings. Vigilance is necessary in keeping down (or up) the number of catalog cards piling up behind one heading.

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[1] Pettee, Subject Headings: The History and Theory of the Alphabetical Subject Approach to Books, p. 81.

[2] Henry B. Van Hoesen, "Twelve Rules for Economy in Subject Headings," an Appendix in Pettee, Subject Headings: The History and Theory of the Alphabetical Subject Approach to Books, p. 163.

[3] Haykin, Subject Headings: A Practical Guide, p. 10.

The Definition of Specificity

The last section of this Chapter has discussed the function of the specific entry principle and attempted to single out the factors which over time have proved its usefulness. The question to be considered in the present section is whether there is some common ground for understanding the concept of specificity. The answer is approached by elaborating seven different types of specificity, or specificity relations, on which one might expect to find more or less agreement. While this may be regarded as an exercise only in language analysis, it is perhaps exactly what is called for in trying to understand a concept generally agreed to be relatively vague, amorphous, etc. Each of the seven definitions of specificity represents only a partial explication of what is meant by the concept, but each does something towards clearing part of the confusion.

To begin with, it can be observed that it is often not the concept *per se* which causes trouble. The abstract concept of specificity is after all somewhat of a reification. The trouble is more particularized. Disagreement arises in special cases where it is difficult to decide whether one word is more specific than another. The relation of specificity (*a* is more specific than *b*) may or may not hold between two words (strictly: between two senses of meanings). For instance, *dog* is more specific than *domestic animal*, while *dog* and *icebox*, as far as any specificity relation goes, might well be considered to be incomparable. It happens, but it is not so common, that the specificity relation holds between two different senses of the same word. Algebra, denoting a special kind of mathematical system ("a ring whose elements can be multiplied by elements of a specified field in accordance with special rules") is more specific than algebra, meaning the modern algebra which treats of the deductive properties of all such mathematical systems. The problem of specificity can be perceived then in terms of specificity relations. Given two words, a and b, it can be asked how much consistency is there in judgments of the type: a is more specific than b; that is, how unambiguously is the specificity relation defined.

i. There is a sense in which the specificity relation can be defined completely and unambiguously. This is to regard it as the mathematical relation of inclusion. As the inclusion relation is normally defined, it is reflexive, antisymmetric and transitive.[1] The relation is understood as holding between classes or sets of elements, which makes possible another definition, this one in terms of set membership: one class A is included in another class B if all the members of A are also members of B. A point of some interest to note is that in the abstract theory or calculus of classes it is always possible, given a non-empty class, to find a different class which is included in this class. Given any non-empty class one may separate off those members which satisfy some condition and form the class consisting of just those members. For instance, knowing that the class of mammals exists, one can assert the existence of a class of mammals which have the further property of being reasonable. Thus the property "reason" enables man to be separated from mammals in general. The example is a little misleading since in a formal mathematical language, such as the theory of classes, there are no "meanings" attached to the elements of the language; classes and their members are represented by letters, not by names such as "*mammal*" or "*man*." The theory of classes is an abstract language, yet it is one in which there can be no doubt at all as to what is meant by inclusion, whether one class is included in another. Unambiguously defined by postulates, the inclusion relation is independent of "meanings" in the ordinary sense; it is very much above exception or disagreement. Specificity defined in terms of the mathematical relation of inclusion could be called "formal specificity." Formal specificity is too precise to have more than a very limited application, but it is important because it can be seen to represent or model in a pure, idealized form other more interesting (and more confusing) types of specificity in ordinary language.

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[1] These conditions are formulated as follows:

reflexivity $A \subseteq A$
antisymmetry $A \subseteq B \;\&\; B \subseteq A \rightarrow A = B$
transitivity $A \subseteq B \;\&\; B \subseteq C \rightarrow A \subseteq C$

See Patrick Suppes, Introduction to Logic (Princeton, N.J.: D. Van Nostrand, 1957), Chap. 10.

ii. In meaningful or colloquial language the inclusion relation is often used with nearly the same precision as in an abstract mathematical language; in these uses it satisfies the same properties of reflexivity, antisymmetry and transitivity. Presumably in all natural languages there are some words which, more appropriately than others, can be characterized as class terms. These are the words which quite naturally lend themselves to extensional definition. The extension of a word covers all the objects denoted by the word. Cat, for instance, can be defined as the class consisting of all cats. The definition is understood by forming the class in a mental way, that is, by abstracting from all things a common characteristic, in this case "catness." Similarly one can form the class of domestic animals, and in the process of abstraction it is seen that all those things characterized by catness are domestic animals as well. It would be fairly agreeable then to conclude that cat is more specific than domestic animal. Only "fairly" because one might pause to reflect, for instance, that a panther can be called a cat but not a domestic animal. It is possible that the extension of any so-called class term can be toyed with, given sufficient imagination. But there are even more confusing difficulties when trying to make decisions about class membership. For instance, are nectarines peaches? The dictionary has it so, but then goes on to point out that "nectarines may arise from peaches or peaches from nectarines." Taking these reservations as limiting but not controverting, it does seem that there is a large domain in ordinary language where the use of the specificity relation follows closely the rules of logic. This is where words can be extensionally defined in a relatively clear way.

There is trouble at once, however, when this concept of specificity is extended beyond its legitimate domain to other parts of language, for instance to abstract words such as good, true, and beautiful. It is difficult to define these words by extension. One of the characteristics of words which can be extensionally defined is that their meanings can be taught ostensively.[1] That is, it is possible to demonstrate the meaning of cat simply by pointing to different cats, however many cats are necessary to give someone the inductive ground for establishing an association between the word and the thing. Abstract words, on the other hand, are not so strongly referential. Only in a Platonic heaven can the good, the true and the beautiful be pointed to. It can be asked if there is a relation of specificity holding between these abstract words. The question is not silly, it seems a consequence of the demand for grounding abstract words, the demand for reference posts to make meanings more precise. It proved a source of difficulty for Plato who believed, and did not believe, that the idea of beauty, as well as the idea of truth, "participated in" (was included in) the idea of the Good. Common sense rebels. It seems as though "specificity" has got out of hand here -- testimony perhaps to the dictum that "philosophical problems arise when language goes on holiday."[2] The relation of class inclusion is a compelling one and attractive. Classifying is a fundamental operation of the mind, fundamental to the ordering of thought and experience. But there can be too much order. The meaning of the inclusion relation is fairly precise, fairly close to its mathematical meaning, when it is used between words which are clearly referential, but as its use is gradually extended to the more heady realms of language, its meaning becomes more diffuse, more vague, more subject to the dispute of viewpoint.

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[1] See Williard van Quine, From a Logical Point of View (Cambridge, Mass.: Harvard University Press, 1953), p. 65 ff.

[2] Wittgenstein, Philosophical Investigations, p. 19.

iii. There is, however, one extension of the inclusion relation into the domain of nonreferential language which seems more warranted than others because of the exactness and simplicity with which the boundaries of this domain can be drawn. In effect, the ambiguity of the relation is controlled by stating a rule which makes it possible to see immediately when the relation holds. This rule can be seen as an extension of the operation mentioned earlier (p. 25) which allows one to form a subclass of a class by introducing a distinguishing characteristic -- mammals plus reason, for instance, gives reasonable mammals or men. This separating operation, used in the abstract uninterpreted language of classes, may be taken as a syntactic analogue of one of the most basic semantic operations employed in ordinary language, namely the operation of modifying. The analogy perhaps is what reinforces the impetus to extend class inclusion beyond words which are clearly referential to words of a more abstract nature: from, say, _reasonable_ _mammals_ to _atomic_ _physics_. It is fairly easy to "picture" the subclass of mammals that are men; it is not so easy to grasp in a conceptual way the elements which form the subclass of physics that is called atomic physics. On the other hand, no one would dispute that atomic physics is a special kind of physics, and thus is more specific than physics. For the most part modification leads to specification. "For the most part" because unfortunately the operation is not always well-behaved. Anomolies can arise. For instance, it is difficult to regard metaphysics, in the sense of "supra-physical" as being specific to physics. The trouble is that not all modifiers pare down the meaning of the words they modify. A particularly troublesome case -- and again one of Plato's worries -- is that of negative modifiers (eg., not) which exploit the words they modify in such a curious way. These modifiers are perhaps not numerous, and at first sight it would seem that they can be rather easily identified. One might thus relegate them to a stop list, so that, with clear exceptions, the rule would still hold that a modified word is more specific than the same word unmodified. This rule deals with pairs of words (strictly: word phrases) between which the relation of semantic specificity holds. It singles out and isolates a special kind of hierarchy. This has been called "phrase-length hierarchy" by Swanson and has been studied earlier on the GLS Indexing Project.[1] One can without misunderstanding also call it "phrase-length specificity." The great advantage of phrase-length specificity is that the specificity relation is defined in a thoroughly clear-cut way, independently of intuition and -- assuming a stop list of troublesome modifiers -- in no way counter to it. The price paid for the disambiguation is that the domain in which the relation holds seems too partial, at least as the specificity relation is usually understood. For instance, it does not hold between the words man and mammal. It is difficult to get some idea of the extent of this partialness. In the context of the retrieval of technical information, it is perhaps not very usual to find modified noun phrases called by other names, for instance the way rational mammal is dubbed man. In any case there is a significant amount of straight modification; and thus there is a significantly large and well-bounded area of language where "specificity" can be said to be viewpoint free.

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[1] Rayward and Svenonius, "Consistency, Consensus Sets and Random Deletion," p. 4.

iv. In the language of mathematics and in that of natural language where meanings are clearly referential or are related by easy modification, the specificity relation is neither relative, nor vague, nor ambiguous. The precision in each case, however, is gained by limiting the domain in which the relation of specificity can legitimately hold. But how useful are these definitions when it comes to making decisions in the structuring of library classification schemes intended to map extensive areas of language, perhaps language as a whole?[1] Semantic tree structures, such as library classification schemes, subject heading lists and thesauri represent partial orderings of words; the relation which accomplishes the ordering is implicitly, even explicitly sometimes, modeled on the ideal logical relation of class inclusion.[2] Quite often the structure of the subdivision of a library classification does correctly express class inclusion -- but very often it does not. Fairthorne gives an "excrutiating" example where the condition of transitivity is violated:

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[1] The Dewey and L.C. classifications might be understood as mapping all of language, since they are intended to handle books on every subject.

[2] Thus in his An Introduction to Library Classification, Sayers writes:

> here is an excrutiating example from the U.D.C. 681.1, Apparatus with Wheel Mechanisms, includes 681.14, Calculating and Adding Apparatus, which includes 681.143.2, Slide Rules. Slide Rules have taken weird shapes in their time, but they are not apparatus with wheel mechanisms. Somebody forgot that not all calculating apparatus has wheels or, more likely, did not bother to look at the main heading.[1]

It seems unlikely that someone "forgot" or "did not bother to look at the main heading" since it is not difficult to find other similar "mistakes" in classification schedules -- mainly because different principles of division are used to form subclasses down the line, partly because headings are just placed somewhere because there is nowhere else to put them. Subject heading lists are also to some degree structured on the relation of inclusion.[2] It is in

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> It is clear that in a classification difference is the determining factor of division itself. Likeness makes the genus, i.e., draws all the species or all the things having it into one family; difference is the something added to these things which abstracts the species or members of the family. In outline, our classification of man shows that

Genus	Difference	Species
zoology	sensibility	animal
animal	backbone	vertebrate animal
vertibrate	viviparous quality	mammal
mammal	reason	man

> Every classification must prodeed on some such lines as these.

From W.C. Berwick Sayers, An Introduction to Library Classification (8th ed.; London: Grafton, 1950), p. 27.

[1] R.A. Fairthorne, "The Mathematics of Classification," Towards Information Retrieval (London: Butterworths, 1961), p. 6.

[2] Pettee writes: "Under the particular topical heading all aspects of the topic may be collected. These particular topics

the "see also" structure of subject heading lists that the inclusion relation is reflected.[1] And again it is used imperfectly, though in this case at least, the deviation from strict inclusion is both conscious and intentional. It is also a matter over which there has been considerable disagreement.[2] The problem is whether the directioning of "see also" references should be reserved for going from general to specific, or whether they should be used also to indicate coordinate relationships. It is a problem of deciding between a rigorous inclusion (specificity) relation or a more flexible, but vaguer, relation of association. The problem is somewhat academic, since in practice the decision is already made -- in favor of the liberal alternative.[3] In any case it is clear that there

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dispersed through the alphabet must still be considered parts of a larger whole with interrelationships to many allied topics. An alphabetical subject catalog as well as a classed catalog must take into account these interrelationships, and to determine them a logical analysis of the topical groups is necessary."
Pette, *Subject Headings: The History and Theory of the Alphabetical Subject Approach to Books*, p. 59.

[1] In the introduction to *Sears List of Subject Headings* one reads: "In general, 'see also' references are made from the general subject to more specific parts of it, and not ordinarily from the specific to the general."
Sears List of Subject Headings, ed. Bertha M. Frick (8th ed.; New York: H.W. Wilson, 1959), p. 25.

"Not ordinarily," but sometimes, and the reference in both directions violates another of the conditions used to define the relation of inclusion, *viz*., that of antisymmetry. In fact the very first entry in Sears List that uses a "see also" shows a downward reference from *abbeys* to *convents and nunneries--monasteries,* as well as a reference from *convents and nunneries--monasteries* to *abbeys*.

[2] See Frarey, *Subject Headings*, p. 42 ff., p. 60 ff.

[3] In rationalizing the decision, Pettee on the structure of subject catalogs writes: "The logic transcends the limits of a classi-

are more relations in both a library classification and a subject heading structure than can be expressed by any strict theory of inclusion.[1] One might say that the specificity relation when it is used irregularly or imprecisely -- as in the slide rule example -- becomes unmoored from its logical foundation, and is, thus, corrupted. Though it is perhaps truer to say that a mathematically precise concept of specificity is not so much corrupted as simply found wanting, when it comes to mapping a larger area of language.

But there is an alternative precision to the mathematical precision which is achieved by the setting up of postulates or conditions. A relation, such as the specificity relation, can be defined exactly by an explicit enumeration of all the pairs of objects (words) for which the relation holds. In other words, a consensus of judgment about specificity (slide rules are more specific than apparatus-wheel mechanisms) need not derive from reason or rules of logic. A consensus can be obtained by force, and this seems to be what happens in practice. The structure of a subject heading list such as Sears must be taken as given; hierarchy is what its authors choose to call hierarchy, the relation of specificity is defined by enumeration.

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fication scheme, for the interrelationships of the special topics reach out into the whole field of knowledge . . . The interrelationships brought together under names in the dictionary catalog are impossible in the logical sequence of strict classification lines." (Pettee, Subject Headings: The History and Theory of the Alphabetical Subject Approach to Books, p. 59.) As was indicated earlier, classification schemes are not particularly limited by considerations of logic. But this is a matter of degree, and Pettee's observation is probably good as a black-white picture of the emphatic difference between subject heading lists and classification schemes.

[1] See Elaine Svenonius, "Library Classification Lattices," Master's Thesis (Chicago: University of Chicago, Graduate Library School, 1965).

There can be no disagreement about the relative specificity of two subject headings, since one can see whether a specificity relation holds in one direction, in both, or not at all, simply by consulting the List to see where in the established hierarchy the headings are located. The List is very definitely an authority list, whose purpose is to impose standardization, to curtail the cataloger's rights of imagination for the sake of uniformity. Catalogers are cautioned about departing from the List, even in the eventuality, which seems probable enough, that a "new" subject emerges.[1]

This juggernaut quality of the List has quite naturally been cause for complaint, though usually authority lists do leave room for some flexibility in the use of the terms they contain.[2] The permissiveness allowed, however, is not so much in judging what is specific to what, but rather in choosing the degree of specificity at which a particular library wishes to operate. (As will be suggested later, as concerns libraries this is perhaps the proper context in which to discuss the relativity of specificity, one where the problem is real.) Not only is there some permissiveness in an authority list, but the government it imposes is not entirely arbitrary. Terms used for subject headings must conform to current American usage:

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[1] "Tentative headings can be assigned, perhaps written in pencil on the cards to be used until the terminology becomes standardized. A list of these tentative headings should be kept (it will never be long) so that they can be reconsidered later and either adopted permanently or changed, as the case may be, and added to the list." (Sears List of Subject Headings, 8th ed., p. 27.)

[2] In the Preface to the ninth edition of Sears, Barbara Westby writes: "A common criticism of any list concerns the degree of specificity in its headings. Specificity is relative and depends on the size of a library, its function, and its patrons. In a small collection, the use of too specific headings can result in scattering like materials. Practicality rather than theory should determine the degree of specificity. Sears, by example or instruction, suggests 183 classes of headings that may be added by the cataloger. The provision of 126 subdivisions further increases the degree of specific entry a library may use." (Sears List of Subject Headings (9th ed.: New York: H.W. Wilson, 1965), p. 6.)

> As a general rule, however, when a term sanctioned by American usage is available for an object (or group of objects), a concept, or a relationship, it may be used as a subject heading. Under this principle there is justification for such specific headings as Autumn, Quatrain, Ultrafax, Waltz.
>
> In fine, a subject heading used in the modern dictionary catalog or alphabetical subject catalog represents a choice of that term to designate the subject which is to be used consistently regardless of the language of the author. This term must, if possible be sanctioned by current American usage.[1]

The making of an authority list, like the making of a dictionary, is not a willful or whimsical undertaking. It happens sometimes that a dictionary definition does not do justice to the contextual subtleties of usage of particular words, but,whether one accepts a definition or not, one still uses a dictionary. If a library user does not consult a subject-heading list, then possibly it is because he already has enough familiarity with the bibliographic mapping of the collection or he has found that that mapping is close enough to a use of language with which he is familiar. Any difficulties that arise because of a divergence between his own language and that of a library can in part be resolved by a simple consultation with a subject headings list. The most compelling reason for coercive specificity is that the consistency it creates furthers the chances for a dialogue between the catalog and a library user.

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[1] Haykin, Subject Headings: A Practical Guide, p. 11.

v. Uriel Weinreich writes that one of the major motivations of semantic research is "a desire to analyze global meaning into components."[1] It has been suggested by Thyllis Williams[2] that a quantitative measure of semantic specificity be based upon the results of this kind of componential analysis. In developing the idea, Miss Williams focuses her attention on a special class of word meanings, viz., meanings which are "commonly accepted" in the sense that they can be found in a standard pocket dictionary. A thesaurus constructed of hierarchies of these word meanings can be obtained by turning a dictionary "inside out," that is,by subordinating every defined word (strictly: word sense or meaning) to each of its defining words. Roughly, the specificity of a word is proportional to the complexity of its definition. Man is more specific than mammal because to the definition of mammal one must add another component, viz., the distinguishing characteristic "rational." Intuitively it would seem that there must be some correlation between the specificity of a word and the number of components used in its dictionary definition. It is apparent at once, however, that certain qualifications must be made. First, not all the components in a dictionary definition are equally significant. For instance some prepositions and other common words are not particularly descriptive and they therefore contribute little to the meaning of the word being defined. The problem becomes more complex when one realizes that there is no sharp boundary between words which are descriptive and those which are not; words are only more or less descriptive. Secondly the syntax of the definition must be considered. Words which are used disjunctively in a definition (eg., "new" as defined as "recently discovered, recognized or learned about") can be regarded as contributing essentially less to the definition than words not so used ("inquiry" defined as "a request for information"). More examples could be given and of a more complicated nature, the point being that the analysis of dictionary definitions requires thoughtfulness and care. Consistency requires that such an analysis follow a well-defined set of rules. The result of applying these rules to a dictionary definition is called a "definition abstract." The definition abstract consists of the components of the definition selected as significant, and a weighting of these components according to their significance.

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[1] Uriel Weinreich, "Explorations in Semantic Theory," Universals of Language, report of a conference held at Dobbs Ferry, N.Y., April 13-15, 1961, ed. Joseph H. Greenberg (Cambridge, Mass: M.I.T. Press, 1963), p. 405.

[2] Thyllis M. Williams, "Standardized Abstracts of Dictionary Definitions," Studies in Indexing Depth and Retrieval Effectiveness (NSF GN 380/654) (Chicago: University of Chicago, Graduate Library School, 1968).

Having thus obtained definition abstracts of words, it would seem that the specificity of the words could then be measured by counting significant components. But even this is too simple because the complexity of the components themselves must be taken into account. There is reason to hope, however, that by carrying the process of abstraction through level after level of definition (i.e., abstracting definitions of definitions) one will eventually approximate a set of atomic components, what might be called the "basic English of definition." It is at this point then that the specificity of a word could be measured by counting the number of atomic components needed for its definition. This work on componential specificity is not finished yet, but continues to be carried out in increasing detail and sophistication by Miss Williams.

There are two advantages to the concept of componential specificity. The first is that by going beyond taxonomy it can be used to provide a measure according to which all words are comparable with respect to specificity. For instance it makes the specificity of slide rule less than, equal to, or greater than that of eternity. This may be somehwat unintuitive, but it is at least as acceptable as the "atomization of meaning" and the semantic tradition to which it belongs. The second advantage is that,when one approaches specificity in this way,use is made of a great body of scholarly research on meaning, viz., the dictionary. Such an approach is firmly objective about meaning and meaning relationships in natural language, more objective, say, than that seen in the quick, expedient and often ad hoc construction of special purpose thesauri.

vi. So far it has been seen that the ambiguity of specificity is diminished when it is understood in terms of a strict inclusion relation, "strict" in the sense of the relation having a limited and well-defined domain, either in mathematical or ordinary language, or when each of the special cases of the specificity relation is enumerated in the form of an authority list or a thesaurus which is more or less sanctioned by ordinary language. Another approach to finding some common denominator in specificity-viewpoints is to study directly the common usage of language, in particular what might be called the "sociology of classification." Appropriate to such a study are socio-linguistic experimental methods, especially those making use of questionnaires. The objective would be to discover and measure the amount of consistency to be found in different people's opinions about specificity. An experiment might be designed, for instance, wherein people are asked to order words on the basis of their intuition or immediate perception of specificity. The results could be expected to indicate how regular the specificity relation is from the point of view of shared language behavior. A possible difficulty with such an experiment is that there are many instances where common sense would balk at having to make a decision about a relationship; for instance, shoe and eternity might naturally be regarded as being outside the proper domain of a specificity relation, i.e., as being incomparable. To force an ordering where none seems immediately apparent could result in some fairly arbitrary classification patterns, with little chance of overlap. On the other hand an experiment need not be so blunt, and more subtle studies of language behavior using questionnaires would be useful in bounding the domain where there is consensus as to the "correct" use of the specificity relation.

vii. A seventh type of specificity is one which seems particularly applicable to language as it is used in indexing the collection of books or documents in a library. This specificity has been referred to on the GLS Indexing Project as "operational specificity or simply, "breadth." The term "operational" is used to distinguish this type of specificity from any of the preceding types,which may be loosely referred to as "semantic" specificity. The operational specificity or breadth of an index term or subject heading is defined as the number of items in the collection indexed by the term, that is, the number of postings made to the term. The average breadth of indexing for a given collection is the number of documents indexed by an "average" term, or the total number of term postings divided by the number of terms in the vocabulary used to do the indexing. In other words, the breadth of a term is its frequency of occurrence. Average breadth is average frequency of occurrence.

There are several points to be noted about this definition of breadth. The first is that the definition is an extensional one, the extension in question being an extension of a particular and very definite kind. As was indicated earlier the extension of a word in ordinary language is its denotation, or the range of objects to which the word may be applied. Analogously the extension of an index term may be considered to be the books in a collection to which the term is assigned. There is some precedence in the literature of indexing for regarding an index term as denoting a class of documents:

> The index term 'Newfoundland' refers, therefore, to the class of documents in which the individual entity 'Newfoundland' is discussed. That such a class (or group) of documents exists is indisputable. That the further use of the index term 'Fauna' would serve to describe another class of documents is equally true, and the conjoint of the

> two would designate a possible class of documents in which the fauna of Newfoundland were discussed, even though no example of the class were immediately available in the collection.[1]

A class of documents or books is the referent of an index term, it is what is "indicated" by the indicating function of the term, and it is what is retrieved by the term in an information retrieval operation.. . . in short, it is an extensional or operational meaning of the term. Within a given collection the number of items in such a class can be counted, and thus one is provided with methods for obtaining the quantification necessary for a theoretical or empirical study of the effect of breadth (specificity) of term on retrieval performance.[2]

The definition of operational breadth makes use of statistics -- the statistics of an indexed collection of documents -- rather than semantics. As was just seen, however, there is an analogy between at least one kind of semantic meaning, viz., denotative or extensional meaning, and the meaning of an index term when it is regarded as referring to a class of books. But it is an analogy only, and must be regarded as such. The difference is that in one case the objects denoted by words are things in the real world, in the other, books in a library collection. It is perhaps interesting to ask how far the analogy can be pushed, how much correlation there is between operational and semantic (extensional) breadth. One of the objections that can be advanced against the definition of operational specificity is that it is counterintuitive in the sense that if in one library there are 10 books indexed by Dog and only five by Mammal, then mammal is more specific than dog. The specific entry principle precludes the use of a suitable broad term when another suitable but more specific term might better describe a book. This has the effect -- desired -- of facilitating searching and retrieval by preventing too many entries from accumulating under any one subject heading. And it can quite easily happen that there are fewer entries under Mammal than under Dog. This example would suggest that there is, in fact, no correlation at all between semantic and operational breadth. It can be argued, however, that a correlation can be seen if one takes into account implicit entries in the catalog. That is, if all books on dogs were counted as though they were indexed under Mammals, then there would be ten books on dogs and fifteen on mammals -- and the semantics would be straight. The semantic-operational breadth correlation can be superimposed in a more formal way by introducing a thesaurus together with a rule which says that if a book is indexed by a semantically specific term it is automatically regarded as being indexed by any more inclusive term. According to this rule the class of books on dogs would be regarded as being included in the class of books on mammals. A retrieval search is broadened by replacing the search term Dog by the term Mammal. The semantic breadth of the search term is increased here; within any given collection, there must be, quite automatically, a corresponding increase in operational breadth, so long as the collection contains some books on mammals that are not also dogs. Artfully then, a correlation can be established between semantic and operational breadth.

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[1] Center for Documentation and Communication Research, School of Library Science, Western Reserve University, "Comments on 'A Logician's Reactions'," American Documentation, VIII (April 1957), pp. 120-121.

[2] Breadth or operational specificity as it has been defined is understood to be a property of an index term, viz., the number of documents to which the term is assigned. One can also speak of a relation of operational specificity. A strict interpretation of the relation would be to regard it simply as the inclusion relation holding between classes whose members are books. Thus if all books indexed by fluid mechanics are also indexed by mechanics, then fluid mechanics is in specificity less than or equal to mechanics. The inclusion relation is the strict one discussed earlier, having the properties of transitivity, reflexivity and antisymmetry. A weaker interpretation of the relation of operational specificity can be obtained by relaxing the condition of antisymmetry which makes it possible then to say that one term is less specific than another if it indexes fewer books. The weaker interpretation has the advantage that all terms become comparable with respect to specificity.

Though it is true there is some correlation between semantic and operational breadth, it is important to be aware of the differences, as these are important in understanding the operation of an indexing system or a library classification. The question of correlation is a particular formulation of a wider question about the relationship of an indexing language to language in general. An earlier approach to this question was to distinguish between natural and artificial classification,[1] and then to ask: does a library classification reflect the structure of knowledge (information) -- and perhaps in so doing describe a natural order of things; or is the ordering simply a convenient and somewhat arbitrary ordering of books? The distinction here is between bibliothecal and scientific classification, between words being used to indicate classes of entities, and words used to indicate classes of books. Superficially the language that orders books looks to be the same as the language that orders the world. But it is impossible to imagine a complete isomorphism between books and things. The same language used for two different purposes is not exactly the same. A word used as an index term or a subject heading is not the same as itself when it is used to describe something in the world. In Wittgenstein's terminology, the one word belongs to two different "language games," and between these two games there are similarities as well as differences. And between semantic and operational breadth there is and there is not a correlation.

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[1] See W.C. Berwick Sayers, A Manual of Classification for Librarians and Bibliographers, 2nd ed. (London: Grafton, 1944), esp. Chaps. II and IX.

A seeming disadvantage of the definition of operational specificity is that it makes the breadth of any term relative to a particular collection of documents. It can happen, for instance, that a given term is broad in one collection and quite narrow or specific in another, depending upon the nature of the collection and the public for whom it is indexed.[1] But it can be argued that a definition that allows breadth to be relative is in fact quite accommodating in that it reflects a fairly accurate picture of just what is the case. Different libraries find it expedient to operate at different levels of specificity. It is generally assumed[2] that the larger the library the more specific must be the subject headings it uses. One library, for instance, may have 1000 books in its collection appropriately headed Printing, while another may have only 10 books on this subject. For ease of reference the first library may choose to subdivide its books on printing, for instance into geographic categories, Printing-U.S., Printing-France, etc. Ease of reference would not require this in the second library. The relativity of specificity perhaps loses some of its disturbing quality if the question "How specific is specific?" reads "How precise is precise?" For one rather expects precision to be relative. At least the rejoinder "precise enough for what?" seems acceptable. In the context of assigning headings to books in a collection, the question "specific (precise) enough for what?" can be answered, "specific enough for easy reference." It seems important to distinguish between questions about the meaning of "specificity" (how is the specificity relation understood) and the question: how specific (precise) must a description be to be useful for some purpose, for instance for indexing a book in a particular library? It is the latter question which most properly engenders comments about the relativity of specificity, since there is no single description which from a global point of view is correctly specific, there are rather many different descriptions made to suit different purposes or requirements. It is in a context such as this that a definition of operational specificity is useful. Operational specificity is decidedly relative, but it is clearly and unambiguously so. Its relativity reflects the very legitimate variability not of "specific," but of "appropriately specific, specific enough for some purpose."

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[1] See the reference from Sears, cited earlier, p. 34. And Lilley writes: ". . . if the same book is described satisfactorily at different levels of specificity depending on the library collection to which it belongs, it can be said that 'specificity is in part a function of a particular library'." (Lilley, "How Specific Is 'Specific'? " p. 5).

[2] See for instance Pettee, Subject Headings: The History and Theory of the Alphabetical Subject Approach to Books.

Finally the definition of operational specificity makes explicit a concept of specificity used in natural language, in particular "specificity" as it is used in the application of the specific entry principle. As was seen[1] an important function of the specific entry principle is to insure that not too many entries accumulate under any one heading, a situation that would make searching tedious, that would detract from "easy reference." With observation that it is also possible to err in the other direction and to have too much specificity with too few entries under one heading, the intent of the specific entry principle is clarified in a significant way. It can be argued that it was never intended to mean "be as specific as possible," the intent was rather to be relatively specific, to "be only as specific as necessary." Pettee's remark might be repeated here:

> As the choice between the most specific term (which can be used as a heading) and a more inclusive one depends entirely upon the number of items which will be likely to collect under the more inclusive terms, a safe rule would be to prefer the more inclusive for less than a dozen titles.[2]

In other words, the operative factor in determining the specificity necessary is the number of items posted to a given heading, viz., the operational breadth of the heading.

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[1] See pp. 20, 21 and 22.

[2] See p. 22.

Summary

Wittgenstein writes that "philosophy is a battle against the bewitchment of our intelligence by means of language."[1] As a method of approach, the philosophical one seems appropriate in dealing with the confusion which has centered around the concept of specificity, a concept of special importance in the theory of indexing. The method demands the making of distinctions. The question which begins this paper is "How specific is specific?" -- a somewhat vague question, and largely rhetorical, intended only to underscore the fact that "specificity" is viewpoint dependent. Though the concept of specificity may have vague boundaries, there is a large area in the center which is not vague -- that is, there are many particular cases where there can be no viewpoint-generated misunderstanding at all as to its meaning. A simple illustration of this is to observe that the following classification can be funny:

> In this text, Borges quotes 'a certain Chinese encyclopedia where it is written that "Animals are divided into a) belong to the Emperor, b) embalmed, c) tamed, d) suckling pigs, e) sirens, f) fabulous, g) dogs at liberty, h) included in the present classification, i) which act like madmen, j) innumerable, k) drawn with a very fine camels hair brush, l) et cetera, m) which have just broken jugs, n) which from afar look like flies'".[2]

The main thrust of the present chapter has been to consider what common ground there is for understanding the concept of specificity. Seven different types of specificity or specificity relations on which one might expect to find some agreement were discussed. They are, in summary:

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[1] Wittgenstein, Philosophical Investigations, p. 47.

[2] Quoted by Richard Poirer, "The Politics of Self Parody," Partisan Review, XXXV (Summer 1968), 352.

1) Formal Specificity: Specificity can be defined in terms of the logical relation of class inclusion. One class A is more specific than another class B if and only if A is properly included in B. Formal specificity is an abstract concept and is divorced from the "meanings" of ordinary colloquial language. Much of the apparent relativity of semantic specificity can be understood as resulting when formal specificity is extended in imperfect and irregular form beyond its legitimate domain to the whole of language.

2) Extensional Specificity: In ordinary language the specificity relation (regarded as inclusion) is used with logical precision when it holds between classes that can be clearly defined in extensional terms. There specificity is not relative; no one would disagree that cat is more specific than mammal, but there would be little agreement that beautiful is more specific than good.

3) Phrase Length Specificity: One extension of the inclusion relation into the domain of nonreferential language seems fairly unambiguous. This is when specification is regarded as modifying. There are exceptions, but generally it holds that a word modified is more specific

than a word unmodified. Red house is more specific than house.

4) Coercive Specificity: The specificity relation can be defined more or less well by enumerating all the pairs of objects (words) between which the relation is supposed to hold. In effect this is what is accomplished by the construction of thesauri, classification schedules and authority lists. There can be no disagreement in practice about the relative specificity of two subject headings; it is simply a matter of consulting an authority list to see whether a specificity relation holds between them, in one direction, in both or not at all.

5) Componential Specificity: A quantitative measure of specificity has been developed by Thyllis Williams. Roughly the specificity of a word is proportional to the complexity of its dictionary definition, where definition complexity is understood in terms of both the descriptive components and the syntax of the definition.

6) Consensus Specificity: Presumably there exists some partial consistency in different people's opinions about specificity, a consensus whose bounds are unknown but might be measurable using socio-linguistic experimental methods.

7) Operational Specificity: Operational specificity is de-

fined in the context of indexing, or assigning subject headings to, books in a library. The operational specificity of an index term is the number of books in the collection indexed by the term. The definition is an extensional one, in that the "meaning" of an index term is regarded as its extension, viz., the class of books to which the term is assigned. Operational specificity is decidedly relative, but it is so in a clear, mathematically measurable way. Its relativity reflects the very legitimate variability not of "specific," but of "specific (precise) enough for some purpose." Further, the definition of operational specificity goes some way to make explicit the concept of specificity as it is understood in the application of the specific entry principle. It does this insofar as the function of the principle is to regulate the number of entries that accumulate under any one heading. In the discussion of the uses of the specific entry principle it was shown that if this is not the main function of the principle, it is at least an important one. Since the operational specificity of an indexing can be measured and since, as will be seen (p. 58), there is a method for systematically varying the operational specificity of indexing, this definition is the one chosen for use in the present experimental study of the effect of specificity on indexing effectiveness.

CHAPTER II

EXPERIMENTAL DESIGN

Introduction

The question, "What is good indexing?" is vague and unclear. It may be that in the long run a question like this cannot be answered in any simple way, yet it is one which has led to much speculation. Perhaps rather necessary speculation, since the belief that some index terms are better chosen than others is the raison d'etre of indexing practice so far as it is not wantonly haphazard but based on indexing principles and authority lists. It has not been until recently that speculation has given way to more objective criteria for evaluating different methods of indexing. Notable in the early attempts at such evaluation is the first Cranfield project (1960)[1] which, under the supervision of Cyril Cleverdon, carried out experiments to test the comparative performance of four indexing systems. Systems performance was measured in terms of the amount of relevant and irrelevant material retrieved in response to search requests addressed to an indexed collection of documents. The importance of the experiment derives from its being the first large scale effort to use objective criteria for determining the relative "goodness" of different indexing methods, suggesting thus that there may in fact be a rational way to choose from among different systems and their conflicting claims.

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[1] Cyril W. Cleverdon, Report on the Testing and Analysis of an Investigation into the Comparative Efficiency of Indexing Systems (Cranfield, England: College of Aeronautics, ASLIB Cranfield Research Project, October 1962).

Since 1960 further experiments, rather more scientific in nature, have been carried out, and other more subtle measures for evaluation have been proposed. At the same time, perhaps as a lesson learned by hindsight from mistakes made in the early Cranfield experiment, there has been a tendency away from the wholesale comparison of different indexing systems towards the singling out of certain individual factors involved in the indexing process and seeing how variation in these affects retrieval performance. Here again the work of Mr. Cleverdon is notable, this time in the Cranfield II project, an experimental study of factors determining the performance of indexing systems.[1] Indexing depth, the number of index terms assigned to a document, is one of the factors affecting retrieval performance. This factor is studied from a theoretical point of view by Swanson in

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[1] The report of the Cranfield II project is contained in the following publications:

Cyril W. Cleverdon, J. Mills and M. Keen, Factors Determining the Performance of Indexing Systems, Vol. 1 -- Design: Part 1 -- Text, Part 2 -- Appendices (Cranfield, England: College of Aeronautics, ASLIB Cranfield Research Project, 1966).

Cyril W. Cleverdon and M. Keen, Factors Determining the Performance of Indexing Systems, Vol. 2 -- Test Results (Cranfield, England: College of Aeronautics, ASLIB Cranfield Research Project, 1966).

"On Indexing Depth and Retrieval Effectiveness."[1] A model of an indexing system is developed which makes it possible to predict the effects on recall and precision when indexing depth is varied by randomly deleting index terms from documents.

Specificity of indexing can also be regarded as a factor that affects retrieval performance. The definition of operational specificity developed in the last chapter makes experimental testing possible, and, as was suggested, this definition at least approximates the meaning of "specificity" as it is implied in the usage of the specific entry principle. And indeed the main objective of the present study is to test the effect on retrieval performance of indexing specificity so defined.

An objection to attempting to find the goodness of an index term in the measure of its operational specificity of breadth, which is a statistical property of a particular indexed collection of documents, is that this takes no account of the relation an index term bears to what it indexes. It seems natural to regard a good index term as one that telescopes sharply the central concepts in the work being indexed, one that in some way is semantically appropriate. The semantic appropriateness of an index term is difficult enough to comprehend let alone evaluate. Intuition, of course, is a method that can be used to determine which index terms best describe the content of the works being indexed. In some indexing practices this intuition is exploited and terms are weighted according to their felt importance to the text. Another method of delimiting semantically appropriate index terms is to assume that certain words, by virtue of their location in positions of importance in the work being indexed, are more semantically descriptive than others and are, thus, the most suitable candidates for index terms. As was seen in the preceding chapter, since the middle of the 19th century the title of a work has traditionally been pointed to as the position of prime importance. A secondary objective of the study is to test the hypothesis that the quality of index terms assigned to documents, rather than their specificity, is the operative factor in retrieval effectiveness.

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[1] Don R. Swanson, "On Indexing Depth and Retrieval Effectiveness,"Proceedings of the Second Congress on the Information Systems Sciences, Hot Springs, Virginia, November 1965, pp. 311-319.

Overview of the Experiment

The Salton-Cranfield data, a subset of the Cranfield II data, has been borrowed for use in the experiment to be described.[1] It consists of 200 documents, mainly in the field of aerodynamics, and 42 search questions to which the documents in the collection have been judged, by subject experts, as relevant or irrelevant. The documents have been manually indexed by trained indexers to a considerable depth, on the average 34.5 terms per document. What recommends this data for the experiment, besides its availability, is that it is the only data where the relevance judgments have been made by subject experts and where an indexing of this depth has been done manually by trained personnel.

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[1] The report of Salton's experiments with the subset of the Cranfield II data is given in: Gerard Salton, "Computer Evaluation of Indexing and Text Processing," Journal of the Association for Computing Machinery, XV (January 1968), 8.

The general testing procedure is the following. The indexing of the documents is systematically varied by deleting certain of the index terms. For instance in one operation broad terms are deleted from documents; in another, narrower terms are deleted; index terms are deleted from a document if they do not also occur in the title of the document; or terms which are not heavily weighted, i.e., not thought especially important by the indexer, are deleted. At each deletion, a subset of the terms originally assigned to the documents in the collection is removed, the purpose being to see if this change in the indexing makes a significant difference in retrieval performance. Thus the "importance" of different sets of terms, broad terms, non-title terms, etc., is judged by the effect of their absence from the indexing of the documents.

After each deletion, the 200-document collection is searched in order to retrieve documents responding to the search questions that are addressed to the collection. The searching procedure is of the usual type where terms used to index the question are "matched" with the terms used to index the documents in the collection. The output of the searching is then evaluated according to different measures of retrieval effectiveness. In this experiment, the familiar precision and recall measures are used, as well as the Expected Search Length (esl) measure developed by

Cooper.[1] The testing procedure then, is to delete index terms, to retrieve documents in response to search questions and to evaluate the precision-recall and esl effectiveness of the altered indexing. Each time these operations are performed, the question is asked whether the esl, precision and recall values obtained using the altered indexing differ significantly from those yielded by the original indexing, before any terms were deleted. The statistical test used to assess the relative effectiveness of the before-and-after deletion indexing is the Wilcoxen Test. Most of the experiment is programmed in PL1; Fortran is used for the Wilcoxen Test. The remainder of this chapter discusses in detail the variables in the experiment, the deletion procedures, the measures of retrieval effectiveness, the Wilcoxen statistical test, the Salton-Cranfield data, and the programming strategy used in the experiment.

The Variables

1) Operational specificity or breadth (B): This has already been defined in Chapter 1. The operational breadth of a term is the number of documents, in a given collection, which the term is used to index. Average breadth $(\overline{B})$[2] is the number

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[1] William Coooer, "Expected Search Length: A Single Measure of Retrieval Effectiveness Based on the Weak Ordering Action of Retrieval Systems," American Documentation, XIX (January 1968),30.

[2] Average breadth is a property of an indexed collection of documents; thus, one can speak of the "average breadth of indexing" or of "average indexing breadth." As it seems unlikely that ambiguity can result, the modifier "average" is sometimes

of documents indexed by an "average term," or the total number of term postings divided by the number of terms on the vocabulary list from which the index terms are selected.

2) Depth (D)[1]: This variable will be defined here in the same sense as that used by Swanson in the paper "On Indexing Depth and Retrieval Effectiveness."[2] Indexing depth is the num-

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omitted: by "indexing breadth" and "breadth of indexing" is meant average indexing breadth and average breadth of indexing. The word average is also omitted in similar expressions of indexing depth.

[1] The term "exhaustivity" is common in the information retrieval literature but is avoided here. Exhaustivity is a measure of the extent to which all the distinct "concepts" discussed in a particular document are recognized in the indexing operation. It is opposed to specificity which is the generic level at which a concept is recognized in the indexing. Conceptual analysis is philosophically a bug-bear. The trouble with concepts is that they are not always clear and distinct; especially in the less hardcore sciences and humanities this is true. Moreover, thesauric relationships between concepts are often ad hoc, subject to point of view, even illogical (eg., Fairthorne's example from U.D.C. where slide rules are specific to apparatus with wheel mechanisms). Occam's razor might be taken to the distinction between exhaustivity of indexing and specificity of indexing, on the grounds that operationally the distinction is not real but exists by definition. Both specificity and exhaustivity can be reduced by moving to a broader class; in the one case by moving up in a thesaurus hierarchy, in the other by moving to a lower cutoff point. However, depending on how "index term" is defined, a move say from "finite wings" to "wings" could be interpreted either as a move in hierarchy or exhaustivity ("finite" and "wings" could be two index terms, or "finite wings" could be one). Indexing and searching are not independent operations. In the literature one sees attempts to separately evaluate these two operations, glossing over possible interdependencies. It can be argued that the difficulties arise owing to a terminology that is not clearly explicated.

[2] Swanson, "On Indexing Depth and Retrieval Effectiveness."

ber of index terms assigned to a document. Average depth ($\bar{D}$) for an indexed collection of documents is the average number of terms assigned to a document, or the total number of term postings divided by the number of documents in the collection.

3) Collection Size (N): This is simply the total number of documents in the collection. In the present experiment N is regarded as a constant.

4) Vocabulary Size (V): It is assumed that in the indexing of documents terms were assigned from a controlled vocabulary or authority list of allowed possible terms.[1] Vocabulary size is then defined as the number of terms on this vocabulary list. This number is a constant throughout the present experiment.[2]

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[1] The actual indexing at Cranfield was not in fact constrained by any sort of vocabulary list. The purpose of the Cranfield II project was to see how retrieval performance is affected by introducing increasingly greater measures of control into the simplest form of indexing, viz., selecting words directly from the natural language of the document being indexed. The purpose of the present experiment, however, is to test the effect on performance of varying the operational breadth of indexing; for this it is necessary to have a precise definition of vocabulary size. It is necessary, in other words, to assume some sort of initial indexing vocabulary or authority list. It seems the simplest way to do this is to regard the full set of terms used to index the original Cranfield II collection as constituting a hypoethetical vocabulary list for the 200 documents in the Salton-Cranfield subset of the collection.

[2] It can be observed that some of the terms on the hypothetical vocabulary list are never actually used in indexing the 200-document subset collection; consequently these terms have breadth 0. It is perhaps aesthetically awkward to allow for null postings, i.e., index terms of breadth 0, and one might contrive to get rid of them by restricting the indexing vocabulary to those terms which are used at least once in indexing the 200 documents. On the other hand it can be said that any definition of vocabulary size that is based on the frequency of term occurrences entails some arbitrariness in cutoff -- should one presume, for

The above variables are related to each other by the following formula: $\bar{B}V = \bar{D}N = T$[1], where T is the total posting frequency. This formula prescribes the experimental method for varying breadth of indexing. Since V and N are constants, if the average depth of indexing is decreased, i.e., if certain index terms are removed from documents, this will automatically decrease the breadth of the terms removed, and, thus, average breadth is also decreased. The method of varying indexing breadth then is simply to vary the depth of indexing by deleting terms from documents.[2]

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instance that breadth 0 is significantly different from breadth 1, but that there is no significant difference between breadth 1 and 2? There seems reason enough for defining indexing vocabulary independently of the index terms actually posted, that is, in terms of an assumed pre-established vocabulary list.

[1] T (total number of postings) can be expressed in several ways:

1) $T = N\bar{D}$
2) $T = V\bar{B}$
3) $T = \sum_{i=1}^{V} \sum_{j=1}^{n} t_{ij}$ i.e., the sum over the document-term matrix. i ranges over the V vocabulary terms; j ranges over the N documents.
4) $T = \sum_{B=0}^{z} B n_B$ where B (breadth) ranges over the z different breadths and n_B is the number of terms of breadth B.

[2] See E. Svenonius, "The Effect of Breadth of Term on Retrieval Performance," Studies in Indexing Depth and Retrieval Effectiveness (NSF GN 380) (Chicago: University of Chicago, Graduate Library School, 1968).

Swanson, in his paper "On Indexing Depth and Retrieval Effectiveness,"[1] examines the effect on precision and recall when the average depth of indexing is decreased in a particular way, viz., by deleting index terms from documents randomly. He finds that recall drops but precision tends to improve[2] when terms are randomly deleted from documents. From only theoretical consider-

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[1] Swanson, "On Indexing Depth and Retrieval Effectiveness."

[2] Precision does not always increase when terms are randomly deleted from documents. For instance, on the case where the retrieval condition is set at the highest cutoff point possible. In this case no documents can filter down into this overlap category and precision after deletion is the same as it was before. Mathematically,

where	N^q_{ipk}	is the number of documents, each with p index terms, which contain k index terms in common with those of a question q. i = 0 refers to irrelevant documents with respect to q; i = 1 refers to relevant documents with respect to q.
	d_{1pkt}	is the percentage of documents with k overlaps that lost t after deletion
and	L	is the ratio of relevant to irrelevant documents retrieved
	P	is indexing depth
	m	is number of terms deleted (See Swanson, "On Indexing Depth and Retrieval Effectiveness.")

Since $d_{1pk0} = d_{0pk0}$,

$$\frac{L_{p-m}}{L_p} = \frac{d_{1pk0}\ N^q_{1pk}}{N^q_{1pk}} \times \frac{N^q_{0pk}}{d_{0pk0}\ N^q_{opk}} = 1$$

Thus $L_{p-m} = 1 \times L_p$, there is no change in L and consequently none in precision (precision $= \frac{1}{1 + \frac{1}{L}}$).

ations then, one can obtain at least a conditional answer to the question: how does the average breadth of indexing affect retrieval effectiveness? The answer is that recall drops and precision tends to improve in proportion as the average breadth of indexing is decreased. The condition is that indexing breadth is varied by a random deletion method. Note that if consideration went no further, the notion of average breadth would be superfluous, since average breadth is a linear function of average depth and anything which can be said of one of these parameters in its relationship to retrieval effectiveness can derivatively be said of the other.

On the other hand, randomly deleting index terms from documents is only one method of varying the average breadth of indexing. It can be asked what happens to retrieval performance when terms other than "the important ones" are deleted. One might characterize unimportant or peripheral index terms to be deleted as those not occurring in the title of the document, or as terms which are not highly weighted, or, in the case of broad and narrow terms, leave judgment suspended and the question open to investigation. Restricting the method of varying the depth and breadth parameters to a random deletion process is a simplifying measure convenient as a first step in a theoretical approach to the question.[1] In an experimental situation, however, a restriction of this sort is not necessary -- it is relatively simple to study the effects on retrieval performance of deleting terms from documents by a systematic nonrandom method. This is what is done in the present experiment; broad, narrow, non-title terms, terms not heavily weighted,are deleted from the indexing of the documents. The concern is not so much with the effects on retrieval of varying the average breadth (equivalently: average depth) of indexing, as with the effects of removing particular classes of terms, those designated as broad, narrow,etc. Average depth and breadth are in a sense extraneous variables; they are therefore held constant under deletion. Whether the terms deleted from documents are broad or narrow, it is always the same number of terms that are deleted.[1] Thus, while different indexings result from the deletion of broad and the deletion of narrow terms, they represent indexings of the same average breadth, average depth and total posting frequency. Although the main

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[1] In W.B. Rayward and E. Svenonius, "Consistency, Consensus Sets and Random Deletion," Studies in Indexing Depth and Retrieval Effectiveness (NSF GH 380) (Chicago: University of Chicago, Graduate Library School, 1967), an attempt was made to study the non-

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random deletion of index terms theoretically. The question asked was what happens to retrieval performance when unimportant terms are randomly deleted from documents. (In the study no attempt was made to characterize important and unimportant terms.) The difficulty with such an approach is that the deletion model becomes subject to even more simplifying assumptions, thus paling further its ability to depict a real situation; at the same time the model becomes so complex and heady it needs more to be explained than it could explain.

[1] Average breadth is diminished equally whether a broad resp. narrow term is deleted from a document, or whether a term is randomly deleted. This is because in each case the total number of postings is altered equally; V and N are constants. (If any k terms from the vocabulary list are deleted from documents, average breadth after deletion is $\frac{T - k}{V}$.)

objective of the experiment is to compare the relative usefulness of broad and narrow terms, it can be said that what, in effect, is being compared are different nonrandom deletion methods. From this point of view the experiment can be regarded as contributing to an understanding of the effect of indexing depth on retrieval performance in that it extends the means of varying depth beyond the random deletion method.

Deletion Procedures

The experiment was conveniently divided into two stages, corresponding to two questions the experiment was designed to answer:

1) Of the index terms assigned to documents,which function most effectively in retrieval, the most used or popular terms, or those which are used relatively infrequently?

2) Do two indexings of comparable average breadth (or depth) differ significantly in the retrieval results they produce because one consists of "quality" indexing and the other does not?

Stage 1: In comparing the effectiveness of broad vs. narrow terms, terms of varying degrees of breadth were deleted from the documents. The first step in classifying terms as "broad" or "narrow" was to obtain the spread of different breadths by listing the vocabulary items in order of their frequency of occurrence, i.e., according to how many times they were used to index documents. The question was how to decide exactly which of the terms should be called "broad" and which "narrow." It was decided that instead of drawing a single line between "broad" and "narrow," more information would be gained if varying degrees of breadth were allowed. The decision was to have four categories of terms: broad terms (those posted most frequently), relatively broad terms, relatively narrow terms, and narrow terms (those posted least frequently). These four sets or quartiles of terms were obtained in the following manner: the total number of term postings to documents was divided by four (T/4). Then beginning at the top of the frequency list of vocabulary terms, i.e. beginning with the most frequent terms, and going down this list, the frequencies of the individual terms were summed until the number T/4 was reached. All terms whose frequencies were summed were said to belong to the first quartile of terms; these consisted of the broadest terms used in the indexing. Continuing down the list, summing frequencies again equal to T/4 gave the second quartile of terms, and so on, for the third and fourth quartile terms. Each of the term quartiles thus obtained represents a subset of the original indexing of the documents, the first quartile consisting of the broadest terms, the second of the next broadest, etc. What these sets of terms have in common, and why they are called "quartiles," is that the total number of postings represented by the terms in each of the quartiles is the same, approximately T/4,[1] or one quarter of the total term postings. A consequence is that there are many fewer unique terms in the first quartile, consisting of broad terms frequently posted,than in the fourth quartile, consisting of infrequently posted terms.

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[1] "Approximately," because it was desired that every occurrence of a given term be in one quartile, i.e., that terms not be "split" with some of their postings in one quartile and some in another; this required making quartiles with slightly less or slightly more than T/4 postings. See note 2, chap. III, p. 93.

There were four deletions of terms from documents corresponding to the four term quartiles. In the first deletion those terms occurring in the first quartile were deleted, the deletion of a term being understood to mean its removal from each of the documents to which it was originally assigned. The retrieval operation was performed and the results evaluated. These first quartile terms were then restored to the documents from which they were taken, and then second quartile terms were removed. And so on. The breadth of an individual term determined whether or not it was deleted, and each of the terms used to index the documents was deleted in one and only one quartile deletion. At each deletion the same number of postings were removed from documents. The rationale for this was to achieve,after each deletion,indexings having the same average depth, average breadth and total posting frequency, the variable of interest being not these general statistics but the breadth of terms deleted. (See p. 62.)

Stage 2: In order to determine whether title terms and heavily weighted terms are especially suited to be index terms, the retrieval power of these terms had to be tested with respect to a comparable set of other "reasonable" index terms. It was assumed that a reasonable index term would be any of those assigned to a document in the original Cranfield indexing. Accordingly the following four deletions were made from the indexing of the documents:

1. From each document, all index terms not also occurring in the title of that document were deleted.

2. The same number of terms was randomly deleted[1] from the indexing of that document.

3. From each document, all index terms that were not given the heaviest of weightings (weight 10) were deleted.

4. The same number of terms was randomly deleted from the indexing of the document.

Deleting in this manner permitted the testing of two indexings that represented two subsets of the originally assigned terms, subsets of equal size but one consisting of "quality" terms and the other of merely "reasonable" terms.

Evaluation of Retrieval

After each of the deletions of index terms from documents, the collection was scanned to retrieve documents responding to the search requests. In the searching procedure, terms used to index the questions were matched with terms used to index the documents. Though there have been various sophisticated matching functions defined in the literature, the one used in the present experiment was a relatively simple one, viz., only exact (machine-like) matches were permitted.[1] The usual definitions of "retrieved," "precision," and "recall" were used. A document is considered "retrieved" if the number of overlaps or matching document-question terms is equal to or greater than a certain specified number, called the cutoff point. Precision and recall are then defined with respect to the relevant documents that are retrieved, and precision is the proportion of retrieved documents that are relevant.

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[1] Note that "random indexing" is used to mean a random sample of the index terms that were assigned to the documents in their first indexing. That is, the terms are not just any haphazard terms, but are, rather, assumed to have some relevance to the documents they index, in as much as they were put on the documents by trained indexers. In the present experiment then, random indexing is a random sample of index terms previously judged as suitable.

The Expected Search Length measure was also used to evaluate retrieval performance. This measure assesses the effectiveness of a retrieval system in retrieving a specified number of wanted relevant documents (s*). The measure assumes that for each search question or request the collection of documents is partitioned into n sets or levels of documents which have, respectively, n, n-1, n-2 . . . terms in common with the question, the highest or top level of the ordering consisting of those documents which have n terms overlapping search request terms. The collection is searched for relevant documents beginning at the top level of the ordering and proceeding down through the lower levels until the requisite number of relevant documents is found. The "Expected Search Length" (esl) is a measure, a statistical expectation, of the number of irrelevant documents that must be gone through before the request is satisfied. Thus esl values increase as the system performs less effectively. The formal definition of esl is as follows:

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[1] The choice of matching function is somewhat dependent on how "index term" is defined. See footnote on p. 79.

$$\text{esl}\ (q) = j + \frac{is}{r + 1}$$

where q is the request for which esl is being determined

j = the number of irrelevant documents found at levels preceding the level where the request is satisfied

i = the number of irrelevant documents at this level

r = the number of relevant documents at this level

s = the number of relevant documents at this level required to satisfy the request

There is a rough correspondence between esl and the precision-recall measure. In a search through a collection of documents partitioned according to overlap, a request for a single document ($s^* = 1$) is generally satisfied at a high overlap level. Thus setting the retrieval condition at a high cutoff level can be regarded as analogous to making a request for a single or few documents. On the other hand, if many documents are requested of the system (for instance all relevant documents), it is not likely that the request can be satisfied at a high overlap level. In fact, if all relevant documents were wanted and it happened that one of these had no terms at all in common with the question, the search for this document would have to proceed down from the highest overlap level through all the succeeding levels until the document was eventually found at the 0 overlap level. Often setting the retrieval condition at a low cutoff level is analogous to making a request for many documents. A low s^* value can be interpreted to mean the user is more interested in precision than recall, a high s^* value can mean recall is preferred to precision.

The Statistical Test

The Wilcoxen matched-pairs signed-ranks test[1] was used to determine whether the esl, precision and recall values obtained after the deletion of terms were significantly different from the corresponding values before deletion. Also compared for significance were different indexings of the same depth: indexing with title terms vs. indexing with the same number of terms chosen randomly from the original indexing; indexing with heavily weighted terms vs. a random selection of the original terms to a like depth.

The Wilcoxen Test is a nonparametric test. That is, it is not conditional upon assumptions regarding the nature of the population from which the sample is drawn -- it need not be assumed, for example, that the sample values are drawn from a normally distributed population. There are advantages and disadvantages to nonparametric tests, the main advantage being, of course, that they are "distribution-free." The relaxing of conditions contributes to the main disadvantage of the tests, viz., they are not as powerful as the corresponding parametric tests when the conditions needed for the parametric model are satisfied. In the present experiment making any assumptions about the population distribution would be unrealistic and there was really no option in deciding between a parametric or a nonparametric model; the nonparametric one had to be used. Since the differences that were being judged for significance were between two related samples (eg., the precision values yielded by two different indexing methods), and since the values being compared represented ordinal measurements, either of two nonparametric tests could have been used: the sign test or the Wilcoxen Test. The tests are rather similar and either would indicate whether one indexing method is significantly better than another. The Wilcoxen Test, however, has an advantage over the sign test in that it can be used to tell not only that one indexing method is better than another, but also how much better. Exploiting information about the magnitude as well as the direction of the observed differences, the Wilcoxen Test is thus the more powerful test, and the one that was chosen for the experiment.

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[1] For a more extended description of the test than is given here see Sidney Siegel, Nonparametric Statistics for the Behavioral Sciences (New York: McGraw-Hill, 1956).

The test makes use of the null hypothesis, the hypothesis of no differences. It is hypothesized that two methods of indexing are equally good; for instance,indexing with a subset of the index terms originally assigned to a document, such as those terms which also occur in the title of the document, gives as good precision values as indexing with the full set of assigned terms. In other words, it is assumed that for any given search question, chance alone determines which of the indexings gives the best retrieval results. The null hypothesis is stated here, as is usual, in the hope that it can be rejected and that the alternative hypothesis, viz., that there is a significant difference between the two indexing methods, can be accepted. To reject the null hypothesis the observed differences in the sample comparisons must be such that they disagree "enough" with the expectation of no difference. That is, the probabilities associated with these observed values must be small, in particular less than or equal to a critical value α . In the present experiment the data were analyzed for critical values of .05 and .01. As no assumption was made as to the direction of the differences, a two-tailed test was used.

The samples being compared in the experiment consisted of sets of retrieval values associated with the individual search questions. For instance, the recall values for each of the 42 questions before deletion were matched with the corresponding recall values after deletion. Each matched pair was given a difference score $\underline{d}$. The next step was to rank the $\underline{d}$'s for the 42 questions without respect to sign and omitting tied scores. Each rank was then given the sign of the difference it represented, tied $\underline{d}$'s being given the average of the tied ranks. The rationale of the test is that if the null hypothesis were to hold, the sum of the ranks having a plus sign would be about the same as the sum of the ranks having a minus sign. The null hypothesis is rejected if either of the sums is too small. Significance was determined first by finding the smaller of the sums of the like-signed ranks, $\underline{T}$. Then, if the sample size was less than 25, a table of critical values for different significance levels was consulted to see if $\underline{T}$ was small enough to warrant a judgment of significant difference. If the sample size was larger than 25, then $\underline{p}$, the probability of the observed difference, was determined by computing:

$$z = \frac{T - \mu_T}{\sigma_T} = \frac{T - N\,\frac{(N+1)}{4}}{\sqrt{\frac{N(N+1)\,(2N+1)}{24}}}$$

z measures the closeness of T to the mean of summed ranks, and a table gives the probability p associated with the value of z at a given significance level. The null hypothesis is rejected if p is less than or equal to α.

A comment about the use of the statistical test in this experiment: although there are 42 questions, the samples compared did not always consist of 42 values. Partly, of course, samples were depleted by the occurrence of tied scores. In the case of precision, however, a more serious reduction in sample size occurred owing to the fact that for many questions precision values were indeterminate at the higher cutoff values since nothing was retrieved and, formally, precision equaled 0/0; and these questions consequently had to be omitted from consideration. This was unfortunate, since the more the sample size is diminished the less power the statistical test has and the more limited the generalizability of the results.

Even in a more general way the inferences which can be drawn from the experimental data, using statistical methods, are limited -- they are limited by the context of this single and rather small experiment. It is not clear, and it cannot be presumed, that the sample data used in the experiment is representative of a population consisting of any search request addressed to any collection of documents. It is possible that the results are descriptive only of this particular collection and this particular set of questions.

The Data

The original Cranfield II collection consists of 1400 documents and 279 search questions. Most of the documents are on the subject of aerodynamics, but a small number of them deal with aircraft structures.[1] The effect of the subject area of the collection on the test results is an unknown[2] and as such qualifies the generalizability of any results using the full data or a subset of the data. The 1400 documents comprise 173 "base documents," 1018 papers that were cited in the base documents and 209 "further" documents selected by students or by the method of bibliographic coupling for their presumed relevance to the set of search questions.[1]

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[1] The purpose of this was to examine the effect of two dissimilar subjects included in one collection. See Cleverdon, Mills and Keen, Factors Determining the Performance of Indexing Systems, Vol. 1, 19.

[2] "We find it impossible to say categorically that the subject area of the test collection did not have an influence on the . . . results." (Cleverdon and Keen, Factors Determining the Performance of Indexing Systems, Vol. 2, 256.) However, Salton points out that the Cranfield documents are substantially more technical in nature and the collection as a whole more homogeneous than most. He speculates that because of the homogeneity of the collection word normalization and synonym procedures are not so effective as for other collections. (Salton, "Computer Evaluation of Indexing and Text Processing," p. 28.)

The 279 questions were obtained from the authors of the base documents. Each author was asked to state in the form of a search question the reason he had for undertaking the research that led to the writing of his paper. He was asked also to compose up to three supplementary questions which either arose in the course of his work or which could be imagined as being put to an information service. A total of 640 questions was obtained, but of these only 279 were selected for use in the experiments. To be selected a question had to satisfy the criteria: it had to be grammatically complete; and there had to be two or more documents in the collection assessed as relevant to the question by the author submitting the question.

Each document was examined for its relevance to each question, an impressive and "onerous" task involving over half a million judgments. The procedure was as follows: each author, when asked to formulate search questions on the basis of his paper, was at the same time asked to judge the documents he cited in his paper as to their relevance to the questions. Relevance was judged according to a 5-degree scale, from relevance 1 for documents which completely answered the question, to relevance 5 for documents of no interest whatsoever. There were, of course, in the 1400-

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[1] While not available for the full document collection, certain characteristics of the base documents are given: each paper contained in its bibliography at least two references in English that were dated 1954 or later: over half the papers were from one journal, the Journal of the Aerospace Sciences; for the most part the authors and bibliographic origin of the papers was American. (Cleverdon, Mills and Keen, Factors Determining the Performance of Indexing Systems, Vol. 1, 19, 20.)

document collection,documents other than those cited by the author that were relevant to his questions -- so every document in the collection had to be examined in relation to every question. The task of "assessing relevance" was performed preliminarily by five students in the field of aerodynamics. But also, as a supplementary measure, preliminary assessments were obtained "automatically" by bibliographic coupling: a document was considered relevant to a search question if it had 7 citations in common with the base document that generated the question. The last and crucial step, i.e., the actual relevance judging, was to send the abstracts of documents thought relevant to a particular question to the author of the question, asking him to make the decision whether the relevance assessments obtained by the students and by bibliographic coupling were actually valid. Asking the author of a question to be the final arbiter of relevance is realistic,and the objection cannot be made that there were documents judged relevant that were really irrelevant. It is not clear, however, that all documents relevant to the questions were found -- that is, some documents preliminarily assessed as irrelevant might really have been relevant. This is another factor that must be considered as qualifying the results obtained using this data. (A fuller discussion is given in the next chapter, pp. 121 ff.) On the average seven relevant documents per question were found.

The indexing of the documents in the collection was a post-coordinate natural language indexing. Natural language phrases, consisting of one or more words, were assigned to the documents.

These phrases presumably designated "concepts." The terminology is perhaps misleading or unnecessary[1] -- the condition imposed on the indexing by the use of the word "concept" is that vague and ambiguous words, words which taken singly might be useless as retrieval handles (eg., modifiers such as "high"), had to appear in conjunction with other words which would provide context and thus, perhaps, a more solid image. Each of the concepts was weighted by assigning to it a value indicative of its relative importance in the document. A range of six weights was adopted, the highest weight being 10 and the lowest 5. For the most part weights were assigned on a subjective basis, depending on whether the concept was in the main general theme of the document or in a major or minor subsidieary theme. Individual terms within a concept were given the weight of the concept, and if a term appeared in more than one concept in a document, it was given the weighting of the more heavily weighted concept.[2]

The main objective of the Cranfield effort was to test the effect of various index languages on the performance of retrieval systems. Indeed this is the rationalization for the hypothesis of concepts -- a concept language was one of the languages to be tested. Another index language tested at Cranfield was called a "single term language."[2] The name is somewhat wrong in that a single term can be thought of as consisting of one or more words, but what is intended is that index terms be regarded as single words or descriptors. This language was formed by taking individual words out of the context of the phrases in which they appeared. For instance, if "finite wings" was assigned to a document, this was to be regarded as equivalent to assigning the two terms "finite" and "wings." At Cranfield a vocabulary list of the unique single word terms used in the indexing of the 1400 documents was drawn up. In constructing the list, use was made of certain minor normalizations, representing "initial controls" of the indexing language. Since roughly the same procedure was followed in the present experiment, these normalizations or initial controls are listed:

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[1] See footnote 1 on p. 56.

[2] Cleverdon, Mills and Keen, Factors Determining the Performance of Indexing Systems, Vol. 1, 55.

[3] Ibid., p. 59 ff.

"(1) Singular and plural forms were confounded.

"(2) American and English and other variant spellings were confounded: e.g., gage and gauge, fiber and fibre, Von Karman and Karman.

"(3) Certain qualifiers of terms (affixes, hyphenated forms which were sometimes separated, etc.) were disregarded, e.g., builtup, pitch-up, rolled-up, etc. were treated as built, pitch, rolled; ellipse-like, jetlike, etc., were treated as ellipse, jet.

"(4) Numbers as qualifiers were separated and treated as separate terms; e.g., Mach 6 became 'Mach' and '6', N.P.L. 18 x 4 (a wind tunnel) became 'N.P.L.' and '18 x 4'."[1] The vocabulary list numbered 3094 single words. In the indexing of the 1400 documents, the total number of "single term" postings was 43,857, the average depth of indexing was 31.3 terms per document and the average indexing breadth was 14.2.

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[1] Cleverdon, Mills and Keen, Factors Determining the Performance of Indexing Systems, Vol. 1, 58.

What has been described are some of the basic features of the Cranfield II experimental data. In the present experiment it was a subset of this data that was used, a subset consisting of 200 documents and 42 questions. The documents and questions were chosen, with the help of a member of the Cranfield group, by Professor Salton for his experimenting at Harvard with the SMART program. A characteristic of this smaller subset of data is that all documents in the 1400-document collection that were relevant to one of the 42 questions were included in the 200-document subset.[1] There were on the average 4.7 relevant documents per question. A possible objection to the Salton-Cranfield data is that there are too few documents and questions to yield results that are generalizable. It is believed, however, at least at Cranfield,[2] that the smaller set of documents is representative of the larger data base, especially for the case of single term indexing. That is, already in previous experimenting the data has been accepted as a reliable inferential base. While this is no guarantee, the availability of the data, the fact that the documents are more deeply indexed than in any other document collection (and by professional indexers) and the integrity of at least those relevance judgments made contribute to making the data the best possible for the present experiment.

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[1] This is not strictly true. Document 1329 is relevant to question 119 and is not included; nor is document 2289 which is relevant to questions 145 and 146.

[2] "Undoubtedly the size of the test collection . . . is smaller than one would have liked. The test results presented in Chapter 4, Section 1, show that the smaller sets of documents and questions were representative of the complete document collection and question set, but these tests were only concerned with the Single Term index languages . . .However, there appears to be no justification for suggesting that the size of the test collection could have significantly affected the comparison between systems." (Cleverdon and Keen, Factors Determining the Performance of Indexing Systems, Vol. 1, 256.

The data tape sent by Mr. Salton contained the weighted concept or phrase language indexing of the documents, a listing of the titles and abstracts of the documents, the questions and a record of the relevance assessments. In the present experiment use was made of only the indexing of the documents. Questions, relevance assessments and document titles were taken from the original Cranfield publications. To prepare the data for use, before the programming could begin, the following tasks had to be performed.

1. Convert the phrase indexing of the documents to a single term indexing in accordance with the normalization procedures followed at Cranfield.
2. Index the questions.
3. Index the document titles.
4. Construct a relevance file, associating with each question the documents relevant to it.

Though something may be lost in the breaking up of phrases, there were definite reasons in the present study for preferring index terms to be single words rather than phrases.[1] And, for the results of retrieval experiments have tended to be somewhat blurred by an overelaborateness and consequent confusion in the details of the experiments. Where possible it seems advisable to let definitions conform as much as possible to what is easily and already understood.

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[1] One advantage to a single word index language is that it is familiar -- keywords and descriptors being now part of standard index usage. The advantage is not negligible in that, in the past,

A second reason for preferring index terms restricted to single words is to safeguard against the possibility that certain deletion procedures could be made to look problematic. For instance, suppose "wings" is deleted from one document and "finite wings" from another. It can be argued that while the same number of "terms" are being deleted, there is an important difference in the units of meaning being removed. The argument would be difficult to meet if one concurred in the view that a word constitutes a unit of meaning. It is, of course, claimed both ways, that as units of meaning words are too small (context must be considered) and they are too big (the unit of meaning must be found at the morphological level). Both claims seem reasonable and rather than getting involved, it seems safest to compromise with common sense by confining index terms along with units of meaning to word boundaries. The only problem then is what is a word boundary, see p. 81.

The use of single words as index terms has the further advantage of permitting retrieval to be carried out on the basis of a relatively simple matching function. The matching function is used to determine the number of overlaps between a document and a search question. For instance an exact (machine-like) match of a question word with an index term assigned to a document constitutes an overlap (wings "matches" wings). Admitting word phrases as index terms, however, introduces cases which are not so clear. Does wings match finite wings? Should this be counted as an overlap? If not, some degree of similarity between document and question is missed. If, on the other hand, it is admitted as a partial (generic) overlap then immediately another variable is introduced into the experiment, *viz*., search strategy. This is not to deny the importance of the search strategy variable, only it seems advisable to suppress this complication where the emphasis of the experiment is on other factors.

Finally, a reason for preferring single-word index terms -- one which does not so much rest on arguments from simplicity of design -- is that the use of single words as retrieval hooks does in fact adequately serve the purpose of retrieval. In discussing the results of the Cranfield II project, Cleverdon writes: "Quite the most astonishing and inexplicable conclusion that arises from the project is that the single term index languages are superior to any other type." (Cleverdon and Keen, *Factors Determining the Performance of Indexing Systems*, Vol. 2, 252.) This is all the more impressive as 33 different index languages were compared in the Cranfield project.

most part, it seemed convenient to adopt the word normalizations[1] suggested by Cleverdon (see p. 77). There was one exception: numbers were not used as retrieval terms. Curious to observe is that neither are numbers included in the Cranfield vocabulary list of terms used in the indexing of the original 1400 documents -- the reason, perhaps, being that numbers by themselves, in isolation, are not especially descriptive and might thus be regarded as too common to be used as retrieval terms. In any case, it seems a matter of fairly arbitrary decision whether or not numbers are used in the retrieving of documents. The first task, converting the phrase indexing of the documents to single term indexing, involved another more problematic decision. The trouble lay in the definition of a word. On the Cranfield vocabulary list sometimes a combination of letters would appear as a single word, but in the actual indexing of the documents these letters would appear as two words. For instance, "lessthan" is a single word in the vocabulary listing of terms, but on documents it is written as two words. Conversely, sometimes two words on the vocabulary list are run together in the indexing of the documents and appear as one word, e.g., "navierstokes" and "navier stokes." Something had to be decided and the decision was to let the indexing of the documents be determining in the following way: unbroken sequences of letters that occurred in the indexing phrases assigned to documents should be included in the vocabulary list as "single words," except if these were obviously common words, common being decided on by the Cranfield policy for prepositions, adverbs, etc., which is inferable from the Cranfield vocabulary list. In this manner revisions were made and a modified vocabulary list was drawn up which consisted of 3168 terms, as compared with the Cranfield list of 3094 terms. The Cranfield list is given on pp. 221 - 236 of Cleverdon, Mills and Keen, Factors Determining the Performance of Indexing Systems, Vol. 1. The revised list used in the present experiment is given in Appendix A.

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[1] Word normalization procedures are a matter of degree: singular and plural forms of one word might be regarded as the same term; further, word variants, such as "fix" and "fixing," might be regarded as equivalent; still further, synonyms might be compounded and regarded as identical. The literature shows some discrepancies in judging the usefulness in retrieval or word normalization procedures. Cleverdon finds that grouping true synonyms and word forms makes for improvement in performance, but the improvement is relatively small (Cleverdon and Keen, Factors Determining the Performance of Indexing Systems, Vol. 2, 253.) Salton finds that the more thorough normalization inherent in matching word-stems improves search effectiveness less than compounding singulars and plurals. Salton, however, agrees with Cleverdon in admitting that the differences one way or another are not dramatic. (Salton, "Computer Evaluation of Indexing and Text Processing," p. 28.) In light of the nonconclusiveness, it seems as well to adopt the minor normalizations used in constructing the initial Cranfield vocabulary list of 3094 single terms.

Cards were then keypunched for each document-term pair, showing also the weighting of the term with respect to the document.[1] The cards were of the following form:

Document Number	Weight	Index Term
1302	05	BOUNDARY

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[1] Some of the weights were missing from terms on the Salton tape. In some cases they were dispensable, there being other occurrences of the same term on the same document. Otherwise the weight was regarded as indeterminate.

The cards were alphabetized and duplicates were discarded. A listing of these cards, showing the index terms assigned to the 200 documents, is given in Appendix B.

The indexing of the questions and document titles was kept as automatic (and repeatable) as possible. The rule followed: a word occurring in a question or a document title was to be considered an index term if, under minor normalization (p. 77),it matched a word on the revised vocabulary list. The questions, with the index terms assigned to them, are given in Appendix C. The cards in the question-term file were of the form:

Question Number	Index Term
100	BOUNDARY

The indexing of the document titles can be inferred by looking at the listing of the records in the document-term file. A T was added to a record if the index term assigned to the document was represented in the title of the document (it is only title terms satisfying this condition that are of interest in the experiment, see p. 65). In making the relevance file, the Cranfield distinction of different relevance categories was not maintained, documents of relevance 1 through relevance 4 were considered simply as "relevant." The cards in the question-relevance file took the form:

Question Number	Number of Relevant Documents	Relevant Documents
100	4	1785 1786 1787 1788

A listing of the cards is given in Appendix D.

Programming the Experiment

The data files used in the experiment are the document-term file, the question-term file and the question-relevance file. Before beginning the actual deletion and retrieval operations, three preliminary tasks, for which programs were written, were performed.

1. The terms used in the indexing of the documents were ordered according to their breadth or frequency, and the depth, breadth and posting statistics were taken. The total number of postings was divided by four, and the terms accounting for the postings in each quartile were separated into four not quite but almost equal sets.[1] For use as deletion decks, the quartile terms together with their frequency of occurrence were output on punched cards. A list of the full set of terms divided into the four subsets is given in Appendix E, and the distribution graph is shown in Appendix G, p. 93.

2. The number of non-title and non-weighted-10 terms in each document was counted -- the information needed for this being already punched on the records in the document-term file. Separately for each document and for each of the two types of terms, the same number of terms was selected at random from the original set of index terms assigned to the document. The program to do this punched on a V on a record in the document-term file if the term was selected as a member of the randomly chosen set corre-

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[1] See footnote 2, p. 412, Chapter III.

sponding to non-weighted-10 terms; an S was punched if the term belonged to the random subset corresponding to non-title terms. Thus in the document-term records for a given document, the records marked with S equaled in number those not marked with a weight of 10.

3. From the document-term file all records for index terms that were not also used in the indexing of the questions were removed. This reduced the size of the file necessary to search through in the retrieving operation by about a third. The reduced file was called the small document file and the original file the large document file. A listing of the small document file is given in Appendix F. Note the terms are alphabetically ordered and following each term are the numbers of the documents that are indexed by the term. The reason for this format was to enable one to manually simulate (and check) the automatic retrieval operation by matching question terms (Appendix C) with the document terms in the small file (Appendix F).

The deletion operations were as follows. The four deletion decks showing the index terms together with their frequency of occurrence were each alphabetically ordered. The terms in each deck were then matched against those on the records in the small document-term file, which also was alphabetically ordered. A match signaled that the document-term record was to be deleted. (The listing in Appendix E showing the frequency distribution of terms is divided into four parts, indicating, thus, which terms were removed from the document indexing in each of the quartile deletions). The deletion of non-title terms, non-weighted-10 terms, V and S terms, did not require the matching of two sets of records. A program was written to delete a term-document record if it did not bear a T; if it did not bear a weight of 10; if it did have on it a V; if it had on it an S. (Which terms were removed in each of the deletions can be seen by referring to the document-term records listed in Appendix B.) After each deletion, depth, breadth and posting statistics were taken.

In the retrieval operation, records in the question-term file were matched against records in the small document file, each file being alphabetically ordered. Only exact, machine-like matches were permitted. Thus 100 BOUNDARY, a record in the question-term file, had a match with 1302 15 BOUNDARY, a record in the document-term file. For each question all documents retrieved by the individual words in the question were ordered according to frequency of occurrence. For instance, one document might respond to five words in the same question. This document then, is said to have a frequency of 5 for that question -- which is simply another way of saying that the document is retrieved in response to the question at the 5 overlap level. The retrieval operation just described can be replicated by matching the question terms in Appendix C with the document terms in Appendix F. Fig. 1 is a sample of what the ordered retrieval output for one question would have looked like at this point, had it been printed out.

The next step was to record which of the retrieved documents were relevant. This was accomplished by consulting the question-relevance file in which documents judged relevant to each question were listed. In the set of ordered documents retrieved by a given question, a document relevant to the question was marked with a star (see Fig. 1).

The retrieval output for each question was then evaluated. Recall and precision were determined at 5 overlap levels (cutoff points), k, denoting cutoff value, ranged from 1 to 5.[1] The mechanics of the evaluation consisted simply of plugging in the appropriate formulas the values obtained by counting different sets of documents in the ordered retrieval output. For each question q and for each cutoff point k,

$$\text{Precision} \qquad \frac{\text{number of starred documents retrieved of frequency} \geq k}{\text{total number of documents retrieved of frequency} \geq k}$$

$$\text{Recall} \qquad \frac{\text{number of starred documents retrieved of frequency} \geq k}{\text{total number of documents relevant to question } q}$$

(The program was directed to the question-relevance file to get the value for the denominator of the recall formula, i.e., the total number of documents relevant to question q.)

Expected Search Length was determined for five values of s* ranging from 1 to 5. The esl values were obtained by evaluating the esl formula for each ordered document set. Let k = the frequency or overlap level at which the request is satisfied.

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[1] Larger values of k were not considered for the reason that the average number of documents relevant to any question was 4.7, making it improbable that for cutoff points higher than 5 enough documents would be retrieved to make the results statistically meaningful. Similarly, values of s* above 5 were not considered, it being unlikely that requests for more than 5 documents could be satisfied in sufficient number to make the results statistically worthwhile.

$$\text{esl}\ (q) = j + \frac{si}{r + 1}$$

where j = number of unstarred documents of frequency $> k$

x = number of starred documents of frequency $> k$

r = number of starred documents of frequency k

i = number of unstarred documents of frequency k

$s = s^* - x$ (s^* is the number of documents requested)

There were some special cases in the esl program. It was necessary before using the esl formula to ascertain whether or not the request being considered could be satisfied in the document collection. For instance, it had to be asked if there indeed existed five documents relevant to the search question. If the answer was yes, the formula was applied; if not, the question was given no esl value and was not included in the averages. Another problem was that it sometimes happened that a request could be satisfied but only at the 0 overlap level. In the retrieving operation, documents were ranked according to a frequency of 1 or greater, that is, only documents with at least 1 overlap in common with a given question were "retrieved." Unretrieved documents, documents with 0 overlaps in common with the question were ignored, i.e., skipped over, by the program. This, while efficient for the most part, had the difficulty that for those cases where k = 0, the esl formula as it appears above would not work. Thus for the case where k = 0: when s* is not satisfied by the time the end of the first overlap level is reached, and there are still relevant documents in the collection; a subprogram was introduced, by which the esl variables were differently defined.

j = number of unstarred documents with frequency $\geqslant 1$

x = number of starred documents with frequency $\geqslant 1$

y = number of documents relevant to the question in hand

$r = y - x$

$i = 200 - (x + j) - r$

$s = s^* - x$

Printed output was obtained at this stage. It took several formats, one format being a 42 x 15 matrix, the columns precision, recall, and esl values, the rows question numbers:

Question	Cutoff 1		s*=1	Cutoff 2		s*=2	. . .	Cutoff 5		s*=5
	P	R	esl	P	R	esl		P	R	esl
7079	0.05	1.00	22.00	0.14	0.33	38.00	. . .	---	0.00	---
7100	0.02	1.00	1.50	0.04	0.75	18.31	. . .	---	0.00	---
.	.	.	.	.	.	.	. . . .	.	.	.
.	.	.	.	.	.	.	. . . .	.	.	.
7360	0.05	1.00	2.18	0.12	1.00	2.37	. . .	---	0.00	---

The output in matrix form was punched on cards, one row to a question, for the purpose of facilitating two further operations: obtaining the mean and standard deviation values for precision, recall and esl, and running the test to determine statistical significance. The mean and standard deviations were found for each column of values. In the case of precision and esl, "dummy" values signifying "value indeterminate" or "request unsatisfied" were excluded from the averages. Then each column of values (e.g., precision values for each of the 42 questions) obtained by retrieving documents after each of the deletions was compared for significant difference, using the Wilcoxen Test, with the corresponding column of values for the no-deletion case. Corresponding columns of values were also compared for the non-title vs. S deletion case and for the non-weighted-10 vs. the V deletion. Output of the statistical program showed the ranking of differences in values as well as values for z, T, μ_T and σ_T (see Wilcoxen Test description, pp. 69 - 73).

Summary

The experiment described consisted of two stages. In both stages the indexing of a collection of documents was varied by the systematic deletion of index terms from documents. Documents were retrieved in response to search questions after each of the deletions and the output was evaluated in terms of precision, recall, and Expected Search Length. The Wilcoxen Test was used to determine whether the difference in retrieval effectiveness in the before-and-after-indexings was statistically significant.

In the first stage of the experiment index terms were non-randomly deleted for the purpose of testing the effect on retrieval performance of varying the specificity or operational breadth of the indexing. In four separate deletions index terms of four different breadth categories were deleted from the indexing of the documents. The question asked was, "Of the index terms assigned to documents, which function most effectively in retrieval, the most used or popular terms, or those which are used relatively infrequently?"

The second stage of the experiment was designed to meet the objection that if there is something which distinguishes good indexing from bad, then this is to be found in the relationships individual terms bear to the documents they index, in their textual warrantability rather than in a statistical property such as operational breadth. Index terms assigned to a document but not represented in the title of the document were deleted and the indexing was compared with a set of terms chosen randomly from the assigned terms to a comparable depth. Non-weighted-10 terms were deleted, terms were randomly deleted to the same depth and the two indexings were compared for retrieval effectiveness. The question asked in the second stage of the experiment was, "Do two indexings of comparable average breadth (depth) differ significantly in the retrieval results they produce because one consists of 'quality' indexing and the other does not?"

CHAPTER III

RESULTS

Indexing With Broad and Narrow Terms

Depth, Breadth and Posting Statistics

In the first stage of the experiment both broad and narrow terms resp. were deleted from documents and the retrieval effectiveness of the indexings before and after deletion were compared. Figure 2 (p. 412) shows the distribution, before deletion, of the terms used to index the documents in the collection.[1] The four horizontal lines cutting the distribution curve indicate the upper and lower bounds on posting frequencies of the four sets of terms corresponding to the four separate deletions. In each deletion terms comprising twenty-five percent of the total number of postings were removed from documents in the collection. In the first deletion broad terms were removed, those occurring between 32 and 143 times (first quartile deletion). Secondly, terms with

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[1] Note that the distribution is plotted on log-normal graph paper. The vertical axis (log-scale) shows x = number of postings, the horizontal axis (normal probability scale) shows S = the percentage of terms having x or fewer postings. Quite predictably, the distribution of index term usage is representable as a straight line, that is, the distribution is log-normal. See Nona Houston and Eugene Wall, "The Distribution of Term Usage in Manipulative Indexes," American Documentation, XV, (April 1964), 105.

13 to 32 postings per term were deleted (second quartile deletion). In the third deletion terms with a frequency from 5 to 13 were deleted (third quartile deletion). Finally, narrow terms[1] were deleted, those posted between 1 and 5 times. With each deletion the number of postings removed was 5174,[2] thus at each deletion average depth was decreased from 34.5 to 25.9 and average breadth from 2.17 to 1.63. Table 1 shows the depth, breadth and posting statistics for the indexing of the collection before any deletion and for the four indexings resulting from the original indexings altered by deletion.

Recall Statistics

Recall results are shown in Tables 2,4 and 5 and in Figure 3 (Appendix G). Table 2 shows the mean recall values over the questions in the sample for each quartile deletion, at each of five cutoff points. Next to each value is written the standard error. The standard error in the recall value is computed from the standard deviation of the sample measurements by dividing the standard deviation of the sample, s, by the square root of N:

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[1] Vocabulary terms which were not used in the indexing of the 200-document collection were not "deleted." Strictly then the narrowest terms were never deleted. In the discussion of the results the expression "narrow terms" refers to terms posted between 1 and 5 times. "Relatively narrow terms" are terms posted between 5 and 13 times; "relatively broad terms" are those with 13 to 32 postings per term; and "broad" terms are those with 32 to 143 postings.

[2] 5174 is an average, the range of values is from 5170 to 5178. It was desired that every occurrence on a document of a given quartile term be deleted, which made it impossible to delete exactly the same number of postings each time. See p. 64.

$$\sigma_{\bar{k}} = \frac{s}{\sqrt{N}} .$$

It can be seen from Table 2 that the standard error in the recall values is consistently fairly small, ranging from 0.01 to 0.06. An error in this range is of small importance at low cutoff points where the recall figures tend to be high. At high cutoff points, however, the error becomes proportionately quite large. Generally, as will be seen, any values obtained at high cutoff points are less reliable than those obtained at low cutoff points, and must be regarded with a certain suspicion.

Table 4 shows the recall values for the no-deletion case and for each quartile deletion,and these are juxtaposed with the corresponding precision values. For both recall and precision, it is indicated when a particular value differs significantly from the corresponding value in the no-deletion case.

Figure 3 shows the precision-recall operating curves for indexing before deletion and the indexings after each of the quartile deletions. The operating curve nearest the top rightmost corner represents the best retrieval: 100% precision and 100% recall. Correspondingly the curve falling closest to the bottom left of the graph represents the poorest retrieval.

Table 5 should be looked at in conjunction with Fig. 3 showing the operating curves, in that it indicates when distances between any two of the curves, e.g., indexing with 1st quartile terms removed and indexing with 4th quartile terms removed, differ significantly.

Recall Drops in Proportion to Breadth of Term Deleted

As was to be expected, recall generally drops as index terms are deleted from documents. The largest drop in recall comes with the deletion of the broadest terms and the smallest with the deletion of the narrowest terms. The fact that recall drops in proportion to the breadth of term deleted is not entirely obvious. It is not obvious since at each deletion the same number of postings were deleted, that is, the same number of retrieval hooks were removed from documents, independently of whether the terms deleted were themselves broad or narrow. But then it can be observed that the factor operative here is not postings but overlaps. Confining attention for the moment to the number of documents retrieved (rather than to recall per se), it seems clear that the amount of material retrieved is determined by the specification of the retrieval condition, viz., by the specification of the number of index terms a document and question must share for the document to be considered retrieved in response to the question. The number of overlaps that can be associated with any term is the frequency of the term in the question indexing times its posting frequency in the document collection. In that terms frequently posted on documents tend also to be used frequently to index questions, it is more probable that a broad term will account for an overlap rather than a narrow one. Thus it is more likely that a greater number of documents will be lost from a given overlap category when broad, as opposed to narrow, terms are deleted. In other words, it is not the number of postings alone, but also the number of times different terms are used to index questions that determines the number of documents retrieved by the terms.[1] It is perhaps obvious that the amount of material retrieved in a system is not a simple function of the total number of terms posted to documents in the collection. This fact, however, is useful in explaining why the quantity and, as will be seen, also the quality of retrieval can vary considerably for collections having the same number of total term postings, in effect the same average indexing depth. Important also is the number of different terms posted at least once. The retrieval behavior of a system is different if many infrequent terms are deleted from the indexing of documents or if a few broad terms are deleted, even though the resulting indexings are of like depth.

Fewer documents are retrieved when broad, rather than narrow, terms are deleted, but as yet this says nothing about recall, the relative proportions of relevant and irrelevant documents retrieved. It seems plausible that a retrieval system should work at least to some extent. Indeed such a system would seem perverse or exhausted if the retrieval of relevant documents did not increase as more documents were retrieved -- it would be better not to retrieve at all. The recall results can be explained then by introducing the assumption that if a term has retrieval power (brings in documents) it has, when used to index a question, also recall power (the power to bring in relevant documents). Generally then, comparing broad and narrow terms, fewer documents are retrieved when broad terms are deleted from documents, and thereby the largest drop in recall comes with the deletion of broad terms.

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[1] The same conclusion can be reached by considering a single question. A very broad term occurring in the question, for instance "coefficient," can at a single match retrieve 50 documents. A narrow term such as "isobaric" can bring in only one document. Broad and narrow term deletion will affect the amount of material retrieved in response to this question differently. It can be assumed that what is true of this question is true of all questions -- in general, fewer documents are retrieved when broad terms are deleted.

Exceptions to the Recall Result

There are, however, two exceptions to the general result that recall drops in proportion to the breadth of term deleted. The first exception is that recall is not in the slightest affected at the first cutoff level when the 4th quartile (infrequent) terms are deleted. This is somewhat surprising, especially when one considers that in this deletion over 1000 different index terms were removed from documents. Moreover, the deletion of these terms even at cutoff 2 does not affect recall significantly. The implication is that the over 1000 terms in the indexing vocabulary which have been posted five or fewer times are superfluous when retrieval is performed at low coordination levels. By way of explanation: broad terms cover so many documents, it seems unlikely that at a coordination level as low as 1, an infrequently used term could bring in something new. The term "flow" for instance retrieves 75% of the collection, while a term such as "isobaric" has at best the potentiality of retrieving one document out of 200 -- the likelihood that the single document retrievable by "isobaric" does not also have at least a few other terms as frequent as "flow" among its 34 other index terms is fairly slight. Where the requirement for retrieval is weak (eg., a document need have only one overlap with a question to be considered retrieved), there is almost as good a chance that a document indexed with 35 terms will be matched with a given question as the same document when nine narrow terms are removed from its indexing. In other words, if retrieval is to be performed only at low coordination levels, there is an unnecessary redundance in indexing documents to a depth of 35 terms. At high coordination levels this is not so true. "Isobaric" is no longer redundant if the cutoff point is high and if its presence on a document is essential to secure the needed coordination for retrieval. It could be said that the retrieval power of broad terms is diminished and that of narrow terms increased as the cutoff point is raised. The higher the cutoff point, the more nearly the retrieval power of broad and narrow terms is equalized.

The second exception to the general result that recall drops in proportion to the breadth of term deleted is at cutoff 5 where 3rd and 4th quartile deletions give like recall. Note that already at cutoff 3 the distinction between these terms, i.e., narrow terms (1 to 5 postings) and relatively narrow terms (5 to 13 postings) begins to become statistically obscured (see Table 5). The explanation again is that at the higher coordination levels there is a tendency for the retrieval power of terms of different breadths to become equalized. Rather naturally this tendency is first exhibited by terms that initially differ little in breadth or retrieval power. Table 5 shows that generally (there are only two exceptions) there is no significant difference in recall between deletions of neighboring quartiles: between 1st and 2nd quartiles; between 2nd and 3rd quartiles; between 3rd and 4th quartiles.

Precision Statistics

The precision results are shown in Tables 3,4,6 and Fig. 3 (Appendix G). Some caution is needed in the statistical interpretation of the values for precision. Changes in recall when index terms were deleted from documents were generally statistically significant at the .01 critical value. However, the changes in precision resulting from the deletion of terms were fairly often not significant, even at the .05 critical value.[1] There is a special difficulty with the significance of precision values at the higher cutoff points. The sample sizes for precision values at these points tended generally to be small. Even before the deletion of index terms there were questions that retrieved no documents at all. Such questions could not be included in the sample. Then there were questions that retrieved some documents before deletion but none after, that is, precision went from some positive (usually small) value to 0/0. Indeterminate changes cannot be judged or included in judgments about differences -- they amount to lost cases. The small sample sizes for precision at the higher cutoff points is unfortunate in that the power of a statistical test (the probability of rejecting a hypothesis when it is false) is diminished as the size of the sample decreases. The implication is that inferences about what happens to precision at cutoff 5, to some extent even at cutoff 4, cannot be taken as very reliable.

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[1] A star beside a value indicates that this value represents a .05 significant change over the no-deletion case. A double star indicates that the changed value is .01 significant. An X, which is beside some of the precision figures, indicates that the sample size used to determine significance was too small (<6), primarily because of changes in precision which were indeterminate, for the statistical test to be applicable.

As an illustration of the difficulty with significance at higher cutoff levels, see the precision value (.90) at cutoff 4, 1st quartile deletion. This value represents an increase in precision of nearly 100%, yet in this case the difference in precision is not significant statistically. The sample size here for the Wilcoxen Test is 6 -- had it been any smaller no judgment could have been made either way as to significance. To show that there is a significant increase in precision with a sample size as low as 6, the Wilcoxen Test requires that 6 out of 6 precision figures increase as a result of deletion. That is, if the outcome is to be only .05 probable, every question in a sample of six questions must show an increase in precision (actually there was an increase in precision in five out of the six cases).

In the example given above, one can allow that the statistical test is suspect, lacking in power because of the marginal sample size. This seems credible, especially as a difference of from .48 to .90 seems so large. On the other hand the precision values themselves might be questioned. What is the meaning of "average precision" where samples are small? The precision value obtained at cutoff 4, 1st quartile deletion,is an average of only twelve values. From a quick and intuitive assessment one might say that the difference here over the no-deletion case seems significant because it looks large and the probable error is fairly small (±.08). But,in saying this,one is making a parametric judgment of sorts, a judgment about a difference in averages (means). From a statistical, and less intuitive, point of view it can be asked whether the comparison of means is a reliable indication of difference, when the means themselves are means over a small sample. Especially when there is no *a priori* knowledge about the distribution of the means. While it can be argued that when the sample size is small the statistical test is not reliable, for similar reasons it can be argued that the average precision figures themselves are suspect.

It can be questioned generally whether average precision is a good statistic to describe intuitively or otherwise the comparative retrieval effectiveness of different indexing methods. In cases where there are only a few questions which retrieve documents -- such as happens at high coordination levels -- its meaningfulness seems especially questionable. For instance, in Table 6 it can be seen that the precision differences when the term quartiles are deleted at cutoffs 4 and 5 are seldom significant. It can be argued that this reflects statistical uncertainty, rather than any bona fide result. Anything that is said about precision at cutoffs 4 and 5 must be regarded as suggestive only.

Precision is Never Improved by the Deletion of Narrow Terms

Precision tends to change in proportion to the average breadth of term deleted from the document indexing. There is a high average percentage increase in precision when the 1st quartile (broadest) terms are deleted -- 86%. When the narrowest terms are deleted precision does not change significantly. In two cases, at the lower cutoffs 1 and 2, the change is not even observable, a consequence presumably of the already-noted redundancy of narrow terms when used in conjunction with broad terms at lower coordination levels. (At the higher cutoff points the change in precision when 4th quartile terms are deleted is observable, but not statistically significant.)

The change affected in precision by the deletion of terms is generally a change for the better. Perhaps the most interesting result is the exception: precision is never improved by the deletion of 4th quartile terms, and only at cutoffs 1 and 2 is it improved (and then only slightly) by the deletion of 3rd quartile terms. This result constitutes several counterinstances to the "tradeoff hypothesis."[1] At the same time this result gives weak support to the hypothesis that the narrower the terms used in indexing the better the precision of the results. Only weak support because it must be admitted that the precision values obtained for 3rd and 4th quartile deletions are not significantly different from the precision values before deletion -- except in one case

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[1] See pp. 18-19.

(cutoff 4, 3rd quartile deletion). The exception may be regarded as suggestive of a general tendency.

Counterinstances to the Tradeoff Hypothesis

At cutoffs 3,4, and 5, the deletion of 3rd and 4th quartile terms gives results contrary to the expected tradeoff between precision and recall. It can be asked how this could happen, how the deletion of terms, which decreases recall, at the same time decreases precision. In the random deletion case, as modeled by Swanson,[1] precision generally improves. Swanson hypothesizes that the high overlap categories are denser in relevant than irrelevant documents than are the lower overlap categories. The net result of deletion, at any but the highest cutoff point,[2] is a larger ratio of relevant to irrelevant documents, that is, an improvement in precision.

Swanson's hypothesis is borne out by the data in the present experiment. Nevertheless, in some cases, precision does not improve with the deletion of index terms from documents. To explain why precision behaves in this way, it can be observed that even though the conditions of the hypothesis hold, precision can get worse if a greater proportion of relevant than irrelevant documents lose overlaps in the deletion process. If the deletion process is a random one, it is as likely for a relevant document as an irrelevant one to lose an overlap. But this is not true when terms are systematically deleted from documents. Under conditions of nonrandom deletion the operative factor affecting the change in precision (for better or for worse) is the relative proportions of relevant and irrelevant documents that are dropped from a given overlap category. One cannot presume that this relative proportion will be the same for broad and narrow term deletions. Indeed this is just what the experiment was designed to test, viz., whether broad terms or narrow ones function more effectively in the retrieving of relevant documents. As can be seen from Table 3 and Fig. 3, when broad terms are deleted precision increases, that is, the ratio of relevant to irrelevant documents increases at a given overlap category. But the reverse happens when narrow terms are deleted, at least at cutoffs above 2: the ratio of relevant to irrelevant documents decreases and precision gets worse.

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[1] Swanson, "On Indexing Depth and Retrieval Effectiveness."

[2] Ibid.

As was mentioned, any effect narrow terms might have at the lower cutoff values (1 and 2) is obscured by the gross effect of broad terms. At the higher cutoff values, however, the effect of narrow and relatively narrow terms (3rd and 4th quartile terms) becomes more apparent. At these values the number of documents retrievable by broad and narrow terms is more nearly equalized. When this is the case narrow terms are more effective in retrieving relevant documents than broad terms. This suggests a tentative answer to the question originally posed, viz., which terms are better for retrieving relevant documents, broad or narrow terms? It can be said that at cutoffs above 2, narrow terms are at least relatively better, since deleting them does not even give the benefit of tradeoff, both precision and recall get worse. This result is interesting at cutoff 3. At cutoffs 4 and 5, it must, of course, be regarded as unfirm.

The Effect on Precision of Deleting Broad Terms

The above results are given further support by the fact that the deletion of broad terms at cutoff 3 and above is seen to result in better retrieval performance, signifying thus that at these levels broad terms are not especially good as retrieval hooks (see the operating curves in Fig. 3). Intuitively it would seem that broad terms should be especially necessary if retrieval is to be performed at high coordination levels, simply to insure that there are some documents retrieved, i.e., that there is something in the intersection of document sets retrieved by the coordinated terms. As far as precision is concerned, this consideration is irrelevant -- it is the quality of the documents retrieved that is important, not the fact that documents may or may not be retrieved. Questions that do not retrieve documents are not included in the evaluation of average precision. The consideration more appropriately applies to recall -- however,if recall at the higher cutoff values had been disastrously affected by the deletion of broad terms from the document indexing the operating curve for the deletion of 1st quartile terms would never have crossed the no-deletion curve. Note that the operating curve for the deletion of broad terms crosses the no-deletion curve by virtue of three high precision values, those at cutoff points 3,4, and 5. The latter two values again are suspect, the one representing a seemingly large jump over the no-deletion case is not actually significant;[1] the other value is obtained on the basis of a sample size so extremely small (2) that it is virtually meaningless. The third figure, however (cutoff 3, 1st quartile deletion), is the most stable as well as the most dramatic; it is the figure that effects the crossing of the operating curves; the sample size is fairly large; the standard error is only ±.0568; the precision value represents one of the more highly significant differences from the no-deletion case, significant at less than the .01 level. Cutoff 3 seems to be a critical point. It was observed before that the deletion of narrow terms below this point had little or no effect on precision or recall. At cutoffs of 1 or 2, retrieval is effected by the strength of broad terms alone. At cutoff 3, however, the retrieval power of the low frequency terms begins to become apparent. It would seem from looking at the operating curves that the behavior of broad terms on either side of the critical 3 cutoff is also different. At cutoff 3 or above their removal results in a better operating curve, but not below this point. Table 6 shows that the deletion of broad terms at cutoff 1,2 or 3 results in indexing significantly better than any of the other indexings obtained by deleting terms, as well as no-deletion indexing. Moreover, the precision values are not suspect at these low cutoff points. The implication is that broad terms do not make for good precision.

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[1] See p.100 for a discussion of this case.

Deleting broad terms is a method of improving precision. There is, however, another method of improving precision and this is to raise the cutoff point. And indeed the operating curves show that the deletion of broad terms at low cutoff points is not as effective a move in improving precision as raising the cutoff point. At cutoff 1, no deletions, a 120% increase in precision can be bought at a 15% loss in recall by deleting the 1st quartile terms. By raising the cutoff to 2 a 240% increase in precision can be achieved at a 16% loss in recall. Actually, the price paid in recall increases as the cutoff point is raised. For instance, at the 3rd cutoff point the deletion of these terms represents only an 87% increase in precision at a 56% loss in recall (compared to the 120% precision and 15% recall loss at cutoff 1). Regardless of the precision-recall preference of an individual user, there is more to be gained by deleting broad terms at cutoff 1 than at cutoff 3. The performance curve for the 1st quartile deletion is poor at low coordination levels only because raising the cutoff point is so much better an alternative.

Primarily what is shown by the operating curves is the relative usefulness of the two devices to improve precision: raising the cutoff point and deleting broad terms. An answer is given to the question: how can it be said that narrow terms make for good indexing when using broad terms at higher coordination levels might give better retrieval results? The answer, which, of course, is relative to the statistical properties of the Salton-Cranfield collection, is that up to the critical cutoff point (3 overlaps) it is indeed better to reduce the amount of material retrieved by raising the cutoff point. At coordination levels of 3 or above the more effective measure is to delete the broadest terms. The reasonable user will operate somewhere along the curve defined by the points: 1 cutoff, no deletion; 2 cutoff, no deletion; 3 cutoff, 1st quartile deletion; 4 cutoff, 1st quartile deletion; 5 cutoff, 1st quartile deletion.[1] At which point on the curve the user decides to operate is a matter of individual preference, depending on whether he favors precision or recall -- in effect, depending on how many irrelevant documents he is willing to search through to find what he needs.[2]

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[1] An intuitive estimate of the distances represented between the points on the optimal operating curve can be obtained by describing an imaginary situation where a user is in dialogue with the retrieval system. This user sets his retrieval condition at the 1 cutoff point and finds that he retrieves 50% of the collection. He wants to improve precision -- it is hard to suppose anyone at this point not wanting to improve precision. A decision is made as to how much recall can be sacrificed in the interest of better precision. Suppose that the user wanting more precision is willing to pay for it by an equal (percentagewise) loss in recall. To improve precision then, he would be led to raising the cutoff point until the third cutoff level is reached, at which point the imperative would be to delete 1st quartile terms. He would operate at cutoff 3, 1st quartile deletion. Any further attempt to improve precision would bring no improvement worth the cost, given of course, this user's particular tradeoff preference.

[2] It has been suggested by Swanson ("Searching Natural Language Text by Computer," Science (October 21, 1960), p. 1102) that a decision of this sort be expressed in terms of a penalty factor, the "penalty" being the time spent or cost in reading irrelevant material. Thus the penalty factor (p) is a variable which can take on arbitrarily assigned values. Retrieval results can then be assessed in terms of a scoring algorithm, given by $R - pI$, where R and I are the respective amounts of relevant and irrelevant material retrieved. This scoring algorithm, which in effect converts precision-recall to a single measure for each user, can then be used to locate the best point at which to operate on the curve.

Comparative Effectiveness of the Indexings Resulting From the Quartile Deletions

One might have expected, from the earlier discussion of narrow terms, that the deletion of 4th quartile terms would give the operating curve closest to the leftmost corner of the graph indicating poorest retrieval. Actually it appears that at the three middle cutoff points the deletion of 3rd quartile terms most adversely affects retrieval results, with the 4th quartile deletion running a close second. This would suggest that, on the average, the deletion of terms occurring between 5 and 13 times improves indexing most and that therefore upper and lower limits can be placed on breadth. But it would be wrong to say generally that there is an optimal breadth which is between 5 and 13 postings per term. This is not demonstrable at either end of the spray of operating curves. Actually as far as precision alone is concerned, there is no difference between deleting 2nd and 3rd quartile terms, or 3rd and 4th, or even 2nd and 4th quartile terms at any cutoff point. Only the deletion of broad terms (1st quartile) gives results that are significant. Also for recall, the deletion of broad terms results in retrieval performance significantly different from that of any other deletion, with the minor exceptions of 2nd quartile deletions at cutoffs 1 and 4. While again, for recall as well as for precision, 2nd and 3rd quartile deletions give significantly indistinguishable results. What is warranted by the data is that when a user wishes to maximize recall, the most important terms are the broader ones. If precision is desired, these terms are not so important and infrequent terms seem most effective.

The Effect on Expected Search Length of Deleting Broad and Narrow Terms

The retrieval results evaluated in terms of Expected Search Length are somewhat simpler to analyze in that esl is a single measure of retrieval effectiveness and the results have a slightly different aspect. These results are shown in Tables 7,8 and 9 and in Fig. 4. It can be seen that, with two exceptions only, the deletion of index terms from documents results in larger esl values (poorer performance). The general tendency can be explained by the rationale that the more index terms that are assigned to documents the more information is conveyed by the indexing and the greater the organizing potential of the indexings. Thus the better the retrieval results. This rationale, which incidently is an argument for broad as well as deep indexing, will be discussed more fully below -- it needs qualification (see pp. 127 ff.).

Considering that the deletion of index terms generally results in poorer performance, one can ask whether it is possible to find terms, broad or narrow, which when deleted more seriously than others impair retrieval results. The inference is that these terms contribute most to effective retrieval. Somewhat surprisingly perhaps, it can be seen that the deviation from the no-deletion case which is most often significant is attributable to the deletion of 2nd quartile terms, those occurring between 13 and 42 times. For three out of the 5 possible s* values, the deletion of 2nd quartile terms gives the largest esl values, and moreover, values that are significantly different from the corresponding values in the no-deletion case, in the case when 4th quartile terms are deleted and with one exception, (s*=3), when 1st quartile terms are deleted. The surprise comes from contrasting this result with the precision-recall result where it is the 3rd quartile terms, not 2nd quartile terms, which when deleted give on the average the poorest operating curve. Third quartile deletion, when the esl measure is used, gives significantly poorer values in two out of the five possible cases.

This discrepancy, however, is not really serious. First, it seems one might have expected two different effectiveness measures, even though "roughly" equivalent, to give somewhat different retrieval evaluations -- analogously, as two different maps, a geological map and a highway map present somewhat different aspects of the same terrain.[1] Secondly, the discrepancy is actually insignificant. It was mentioned that as regards precision and recall there is no difference whatsoever -- at any cutoff -- between indexings with 2nd and 3rd quartile terms deleted. Similarly for esl, there is no significant difference at any s* when terms of either these middle breadths are deleted.

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[1] One can speculate on the nature or extent of the relationship between the two measures: while it is easy to see a rough correspondence, the question is not easy how exactly is precision-recall related to esl. Also of speculative interest is the relationship between a measure and what is measured, between a map and what is mapped. It can be asked how well either measure really reflects user satisfaction as regards the utility of what is retrieved. The questions are philosophic, foundational questions. The second is especially important in that any conclusions that are drawn using one of the measures are qualified in a rather basic way by not having an answer to the question "how do we know we are measuring the right thing?"

On the average the deletion of 2nd and 3rd quartile terms causes about a 40% increase in esl. A similar increase in average esl results when broad (1st quartile) terms are deleted. From the point of view of averages, it would seem that an argument could be made that the main variable affecting esl is the number of terms posted -- whether the terms posted happen to be broad or narrow is relatively unimportant. Controverting evidence, however, is given by the deletion of 4th quartile terms, and even by the deletion of the 1st quartile terms themselves. The deletion of the narrow 4th quartile terms results in only an 8% average increase in esl, as compared with the 40% increase that comes from the deletion of terms in other quartiles. Moreover, when narrow terms are deleted, the change in esl is uniformly slight at every value of $s^* > 1$. At $s^*=1$ the change is significant, but barely so. The implication is that narrow terms, those posted less than 5 times, are not as effective in retrieving relevant documents as terms more frequently posted. This result agrees fairly well with the corresponding precision-recall result. It was seen that the deletion of 4th quartile terms makes virtually no difference in precision or recall values at low cutoff levels. At high cutoff levels there was a significant difference in recall, but not for precision. As for broad terms: averaged over all s*, the increase in esl resulting from the deletion of 1st quartile terms differs little from the average increase for other deletions. However, unlike other deletions, the deletion of broad terms gives dramatically different results for different s* values. When s* is small (s* = 1,2) the deletion of broad terms actually improves esl. However, the improvement in esl is not large enough to be significant, and must therefore be considered as no more than random fluctuation.[1] On the other hand, where s* is large (s* = 5), the deletion of broad terms results percentagewise in a larger increase in esl than any other deletion case (57%). This extreme figure at s* = 5 counterweights the "anomolous" figures at s* = 1 and s* = 2, and the rather small deviation for middle values of s*, making thus the average esl for 1st quartile deletions approximately equal to the average esl for 2nd and 3rd quartile deletions.

A request for many relevant documents is the esl situation that roughly corresponds to the precision-recall situation where retrieval is performed at low cutoff points; a request for a few documents is the situation corresponding to a search performed at a high cutoff level. The data shows that this tendency for small requests to be satisfied at high overlap levels and for large requests to be satisfied at lower levels becomes exaggerated when broad terms are deleted from the indexing of documents. Before the deletion of broad terms the average level at which a request for 5 documents is satisfied is the two overlap level. But after deletion, for nearly half of the requests, the search must proceed down into the rather vast 0 overlap level (which is true for none of the potentially satisfiable 5 document requests before deletion). By contrast the average level at which a small request -- a request for 1 document -- is satisfied before the deletion of broad terms is the 4 overlap level, after deletion the 3 overlap level.

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[1] It could be asked how esl could improve at all with the deletion of terms. (Analogously how could precision decrease at all with the deletion of terms, and the consequent drop in recall.) An example can be given to show that, given a small s* and the deletion of broad (not narrow) terms, it is not improbable that esl decreases. Assume that, before as well as after deletion, a request for one document is satisfied at the topmost level of the documents ranked by overlap. This assumption is a fairly reasonable one since this topmost level is densely populated with relevant documents to begin with, and, inasmuch as precision increases, becomes even more so when broad terms are deleted. Esl in the two cases is roughly proportional to the ratio of irrelevant to relevant documents ($esl = \frac{i}{r+1}$), that is, esl is roughly inversely proportional to precision. Precision increases with the deletion of broad terms, and esl therefore decreases. This is a possibility only -- esl of course does not decrease if no relevant documents are retrieved at the topmost level after deletion. However, the chance of this happening is probably negligible -- from the above assumption. To show analytically, in the form of a theoretical proof, that it is either probable or improbable that esl decreases for s* would seem to be unmanageable. All possible alternatives would have to be taken into account -- requests might be satisfied at any overlap level and the level of satisfaction need not be the same before and after deletion. Moreover, it is not clear what the result would mean since it would have to be expressed in terms of expected Expected Search Length.

Indexing With Title and Weighted-10 Terms

Depth, Breadth and Posting Statistics

In the second stage of the experiment there were four deletions of index terms from documents: all index terms not also occurring in the title of the document were deleted and the same number of terms was randomly deleted; index terms that were not given a weight of 10 were deleted and the same number of terms was randomly deleted. The depth, breadth and posting statistics for these deletions are shown in Table 10. It can be seen from the Table that approximately 20% of the index terms assigned to a document also occur in the document title; and approximately 22% of the originally assigned terms are given a weight of 10. The average breadth of indexing after the deletions comes to less than one occurrence per document. This is because so many terms, upon deletion, lose all their postings -- the total vocabulary size, however, remains unchanged.[1] It can be seen that when the deletion of terms is systematic (the deletions of non-title and non-weighted-10 terms) the average breadth of deleted terms is 6.49, whereas when the same number of postings per document are deleted randomly, the average breadth of the deleted terms is 7.23. The implication is that index terms which are also weighted-10 terms or title terms are generally broader than terms randomly sampled, but not greatly so.

Tables 11 - 15 and Figs. 5 and 6 show the precision-recall and esl evaluations of the indexings after each of the four deletions. As before, certain of the precision values at the higher coordination levels had to be discounted because not enough documents were retrieved after the term deletions to warrant comparison with the no-deletion case. In addition to statistically comparing precision, recall and esl values for the altered indexing with the corresponding values in the no-deletion case, comparisons were made between paired random and nonrandom values for indexings of like breadth and depth. For instance, for a given s* the value after title-term deletion is compared to a value resulting from a "comparable" random deletion.[1]

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[1] It will be remembered that $\overline{B}V = \overline{D}N$. See p. 59.

Weighted-10 Indexing

Weighted-10 indexing, the indexing that results when terms not assigned this highest weight in the original indexing are deleted, gives results poorer than the original indexing, and not significantly better than random indexing with the same number of terms. At low values of s* the difference in esl from the no-deletion case was .05 significant; at higher s* values the poorer performance of weighted-10 indexing was even more significant (.01). Moreover, in no case (at no s* value) did indexing with weighted-10 terms differ at a .01 significance level from the corresponding random indexing. Precision-recall results for weighted-10 indexing, when compared to the esl results, are somewhat surprising. They support the esl results in that when weighted-10 indexing was compared with a random indexing of the same depth, there was no case in which the difference in precision was .01 significant, and in only one case was the difference in recall as significant as this. In view of these indications so far of the inferior quality of weighted-10 indexing, it comes as some surprise to see that the precision-recall operating curves show that weighted-10 indexing is essentially better than the full unaltered indexing at cutoff points 3,4 and 5. This result is not even roughly reflected by the esl results for low s* values. In attempting to explain what seems like a contradiction, one might resort to the assumption that the crossing of the precision-recall curves for weighted-10 and no-deletion indexing was due only to random fluctuation. It should be pointed out that the problem of small sample size was particularly acute for the precision measurements on weighted-10 indexing at cutoffs 3,4 and 5. The sample sizes at these points were 11, 6 and 2 respectively -- which in any case seems reason enough to discount the precision values at these points, viz., the precision values that effect the crossing of the operating curves.

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[1] In the Tables brackets are put around paired values that differed significantly.

The case for weighted-10 indexing seems then generally bad. One might conclude that the "semantic quality" of weighted-10 indexing is suspect. That is, among the non-weighted-10 terms removed in the deletion process there were terms important in the retrieval of relevant documents. Alternatively one might conclude that because so many terms were removed in the deletion process (average depth was reduced from 34.5 to 7.4), regardless of the quality of the weighted-10 terms left on the documents, retrieval effectiveness would have been seriously impaired. This second alternative can be rejected in light of the results for title-term indexing, also at a small average indexing depth (see p. 119 ff.). Weighted-10 indexing then must be judged as poor quality indexing. In attempting to understand why, the method by which weights were assigned to index terms by the Cranfield indexers might be reviewed. For at least 80% of the 1400-document collection weights were assigned to terms on a subjective basis.[1] To receive a weight of 10 an index term had to be considered "potent" -- "potent" meaning "concepts in the main general theme of the document."[2] Also there were other conditions to be satisfied, i.e., not all potent terms were given a weight of 10. If the terms were very common (i.e., broad) or very vague (eg. "data") they were weighted less. Thus among the non-weighted-10 terms that were deleted were potent terms that were fairly broad and vague. From the point of view of the present experiment the Cranfield decision to exclude broad and vague terms from the highest importance category was not a good move. As a consequence statistics and semantics are confused, the variables are muddied. As was seen the deletion of broad terms can improve retrieval effectiveness in the high precision regions and detract from it in the high recall regions. Obviously then, the exclusion of broad and vague terms from the weighted-10 category had the effect of overvaluing "potent" indexing in the high precision regions and at low values of s*, and devaluing it in the high recall regions and at high values of s*. It might be noted that even the tampered weighted-10 indexing did not perform as well as the indexing from which the 1st quartile (broad) terms were deleted. The two indexings are incomparable in the sense that the average depth and breadth of the indexings are not the same. Still the Cranfield policy of weighting terms might be questioned.[1] Presumably a costly, time consuming and essentially intellectual operation, the weighting of terms, at least as was done at Cranfield, does not compare favorably with the essentially mechanical operation of not indexing with broad terms. This is perhaps the firmest conclusion that can be wrenched from the data, considering the confusion of mixed variables worse compounded by the discrepancy between esl and precision-recall values. The case for weighted-10 indexing neither supports nor counters the hypothesis that two indexings of comparable breadth differ in retrieval effectiveness because one consists of quality terms and the other does not.

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[1] Cleverdon, Mills and Keen, Factors Determining the Performance of Indexing Systems, p. 55.

[2] Ibid., p. 55.

Title-Term Indexing

The results for title-term indexing are more interesting. There were three cases where the deletion of non-title terms made no significant (.01) change in esl values. These were at s* = 1,2, and 3. In one of these cases (s* = 2) the esl value actually improved after the terms were deleted, though admittedly the improvement was quite insignificant, a drop from 11.76 to 11.60. At s* = 4 the change in esl was significant, but only at the .05 level, i.e., not at .01. At s* = 5 the change was significant at .01. The implication is that if a request is for only a few relevant documents, it is unnecessary to index as deeply as 34 terms per document -- seven terms would do as well, if these terms are title terms; however, if a request is for many or all relevant documents, indexing to a depth of seven terms per document is not sufficient, no matter what the quality of the terms. More terms -- more information -- is needed to partition the collection for effective retrieval.

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[1] Salton finds that weighted word stems extracted from document abstracts are clearly more effective than non-weighted stems (see Salton, "Computer Evaluation of Indexing and Text Processing," p. 24). However,he used automatic weighting methods rather than the weights assigned by the Cranfield indexers, those representing intuitive assessments of semantic relevance.

Comparing title terms with a set of terms chosen randomly from the original indexing to a like depth (breadth), it can be seen (Table 15) that at every s* value there is a significant difference in performance. In every case, title terms are significantly (.01) better for retrieving documents relevant to the search questions. (By contrast, in no case does weighted-10 indexing give .01 significantly different esl values than random indexing of the same depth.)

Evaluation in terms of precision and recall shows that at the higher cutoff levels (roughly corresponding to low values of s*) the operating curve for title-term indexing is better than the curve for the no-deletion case. Also corroborative of the esl results for title-term indexing is the precision-recall performance of title terms compared with a random sample of terms chosen from the full indexing to a comparable depth. At every cutoff value the difference in recall between the two indexings is .01 significant. The difference in precision, however, is as significant as this at only one cutoff point (cutoff 1) but at another (cutoff 3) it is .05 significant. (By contrast weighted-10 indexing compared with the corresponding random indexing showed a .01 significant difference in precision in no case, and in recall in only one case.)

If the average breadth (depth) of indexing were the main variable affecting retrieval performance, one would expect similar effects whether terms were deleted randomly or on purpose. The hypothesis might be stated that particular words in themselves are not important, more important is the actual number of words chosen to index the documents. The results for title-term indexing in the high precision, low s* regions constitute a counterinstance to this hypothesis. It would seem that title terms are quality terms in the sense that they are especially effective in retrieving relevant documents. From this one might infer that there is a correlation between the title of a document relevant to a given question and the fact of its relevance. There is a difficulty here however. It is not clear that the correlation is a real one. It is real only if there is no unnatural bias between a question and the title of a relevant document. An unnatural bias might come about if, for instance, in the original assessments of relevance, some relevant documents, perhaps those with unobvious titles, were overlooked. Very likely this is what happened. The fact that students did the searching for relevant documents, and no doubt their attention was flagged by noticeable titles, makes it probable. Cleverdon was concerned about the problem of unnatural bias and in an attempt to determine whether one existed he examined some of the search questions together with their relevant documents. He found that nearly 1/3 of the questions had a strong question-title match.[1] But the figure of 1/3 can neither prove nor disprove the existence of an unnatural bias. Cleverdon's words are more persuasive: "one would have expected a certain strength of title match in this subject, where titles are usually fairly long and a good indication of the subject of the document,"[2] and "it is wrong to conclude . . . that whenever there is a substantial match between question and title, then the relationship is necessarily unnatural."[3] This seems fair and Cleverdon admits that nothing conclusive can be said on the subject of a title-question bias until questions are obtained from a real life situation and tested in an existing collection. Indeed one might speculate that many "real life" questions are really searches for partially remembered titles, in which case the correlation between question and relevant-document title would be strong and natural. As regards the results of the present experiment, however, it needs and perhaps suffices to be said that they are limited by the assumption of no unnatural title-question correlation.[4]

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[1] Cleverdon, Mills and Keen, Factors Determining the Performance of Indexing Systems, Vol. 1, 38.

[2] Loc. cit.

[3] Cleverdon, Mills and Keen, Factors Determining the Performance of Indexing Systems, Vol. 1, 36.

[4] Salton's results for title-term indexing using this data might be mentioned. Salton compared the automatic indexing of titles with the indexing of abstracts, also done automatically. He finds the abstract process to be superior to the title-only option. This result, while important from the point of view of the feasibility of machine indexing, does not say much one way or

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the other about the special usefulness of words which occur in titles. This is because the titles were indexed to an average depth of 11 descriptors, while the abstracts were indexed to the much greater (average) depth of 91; so what Salton shows is that with 91 descriptors mechanically derived from an abstract it is possible to achieve better results than with 11 descriptors mechanically derived from a title. It seems quite possible that the superior performance of abstract indexing can be accounted for by the greater "depth" of indexing. At least there is reasonable doubt that Salton's experiment demonstrates anything conclusive about the innate value of the particular words used in indexing.

CHAPTER IV

CONCLUSION

The Case for Specific Indexing

The main purpose of the experiment was to answer the question which term functions most effectively in the retrieval of relevant documents, broad or narrow. The answer, as has been seen, is not straightforward, but depends upon what the user of the retrieval system wants, his wants being expressed in terms of a stated precision-recall preference, or, more precisely, by the exact number of relevant documents he wishes to retrieve. This result is not unexpected. At the end of the last century Cutter advised that the principle of specific entry be viewed in light of another principle, *viz*., the usage principle. Over the years there has perhaps been too much concern about the "language" of the users, at least the present study shows that an important operational factor is the user's quantitative needs. Some insight into the nature of the relationship between indexing specificity and user needs can be given by summarizing the experimental results as they bear on indexing with narrow (specific) terms.

The deletion of narrow terms (1-5 postings per term) affects recall less than the deletion of broad terms. Precision is *never* improved by deleting narrow terms. When retrieval is performed at high coordination levels (in the present study at coordination levels greater than 2), the deletion of narrow terms adversely affects retrieval output with respect to precision, as well as recall. Even the deletion of relatively narrow terms (5-13 postings per term) decreases precision at these levels. By contrast, the deletion of broad terms improves precision, at any coordination level, and the operating curve for the deletion of broad terms is better than the curve for the no-deletion case at coordination levels greater than 2. The quality of retrieval in either precision or recall is not affected when narrow terms are deleted at low coordination levels, at cutoffs of 1 and 2. Narrow terms, while important where high precision is desired, are redundant and unnecessary when the demand is for high recall. Retrieval evaluation measured in terms of esl generally supports these conclusions. The deletion of narrow terms does not affect esl values significantly except at the lowest request level where the user wants only one relevant document, in effect where the user wants high precision.

An argument can be made for the "importance" of narrow terms in indexing for quality retrieval. What happens as the cutoff point is raised is that the retrieval power of broad and narrow terms becomes equalized, that is, the difference between the number of documents a term brings in becomes obscured, while the difference in the quality of the retrieved documents with respect to relevances becomes more apparent. The fact that at higher coordination levels the deletion of narrow terms makes for worse precision as well as worse recall suggests that the documents retrieved by narrow terms are more likely to be relevant than those retrieved by broad terms. This difference between the retrieval effectiveness of broad and narrow terms is not fully explainable on the basis of the relative sizes of the document sets retrieved, since, in its demonstration, the tradeoff hypothesis was violated. In other words, narrow terms are essentially good index terms, and not just apparently so by virtue of statistical accident.

The argument for narrow terms must, however, be qualified. There are cases where index terms can be too narrow. If a user is interested in high recall or needs more than one relevant document, narrow terms, though "quality" terms, are ineffectual, the work of retrieval depending on broad terms. It was shown that on the average -- i.e., averaged over different request sizes and different cutoff values -- index terms that are posted between 5 and 32 times are "optimal" judging by the effect of their absence on retrieval performance. One is reminded of Pettee's "guess" of "less than a dozen" postings per term as the lower limit on specificity.[1] It is misleading, however, to speak of index terms of "optimal breadth," since the best breadth of term is a variable -- it varies with the user's decision as to the number of relevant documents he needs or the number of irrelevant documents he can tolerate. Lilley's answer to the question "How specific is 'specific'?" is sound. "Well, it all depends!"[1] But the answer was left hanging. Lilley does allow it depends on user's needs, but intangibly so: "Specificity may be so intangible as to be nothing more in an effective sense than a chance relationship between the user's need of the moment and the format of a particular book an individual library happens to own."[2] Specificity need not be chancy or intangible when user's needs are interpreted in terms of a precision-recall preference or the number of documents desired.

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[1] See p. 22.

The Case for Indexing in Depth

The second purpose of the experiment was to examine the question how important a factor in retrieval effectiveness is average breadth or depth of indexing. It was speculated that perhaps the quality of particular index terms was more significant in the retrieval of relevant documents than statistical properties of the indexing such as the number of index terms assigned to a document or the number of different terms used in indexing the collection. The experimental results that are most interestingly relevant to this question are those for title-term indexing. It was seen that when only one or two documents on a topic were requested, indexing with seven terms taken from the document title, presumably seven quality terms, led to good retrieval performance: in some cases performance results were slightly better, but in no case were they significantly different than indexing with the full 34.5 terms, including title terms, originally assigned to each document. On the other hand, when a request for four or five documents was put to the system, title-term indexing did not perform so effectively, again underlining the importance of the variable "user's needs, quantitatively expressed."

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[1] Lilley, "How Specific is 'Specific'? " p. 8.

[2] Ibid., p. 6.

Cleverdon in the Cranfield II study experimented with title, abstract and full document indexing. In explaining the differences in the results for these three types of indexing he cites indexing depth (exhaustivity) as the "main operational variable."

> There is the possibility that the selection of terms by the indexer was more descriptive of the document content than those terms used for the titles and the abstracts, but the main variable in these five results concerns the level of indexing exhaustivity. It would seem that while the titles were at too low a level of exhaustivity (7 terms per document), the gradual increase in the level, up to an average of 33 terms, brought about an improvement in performance. However, the higher level of exhaustivity represented by the abstracts (probably about 60 terms per document) was too high, resulting in the retrieval of large numbers of additional non-relevant documents.[1]

Cleverdon's opinion might be questioned. The small difference observed between title-and full-document indexing (59.76% and 65.00% normalized recall ratios respectively) may not be statistically significant. Even if significant it seems a little surprising that so small a difference in retrieval performance can be explained by so large a difference in depth -- 7 terms per title vs. 33 terms per document. Moreover, if operational depth is an important factor in retrieval performance one would expect similar effects from indexings of the same depth. But the present experiment offers a counter-instance: title-term indexing proved significantly better than the "random" indexing at a comparable depth. Cleverdon, to support his contention that depth is the main variable, observes that retrieval performance improves with the gradual increase in depth from seven terms per document up to 33 terms per document. The present experiment shows that title-term indexing at an average depth of seven terms per document gives a better precision-recall operating curve than some indexings of 25 terms per document (when the quartile deletions were made). The expression "the main variable" seems somewhat incautiously used. Clearly retrieval performance is a function of the quality of the index terms assigned to a document as well as their quantity. On the other hand, it cannot be denied that the weakness of title-term indexing is its lack of depth. As was seen, this is especially apparent when the number of documents requested of the system is large, when high recall is desired. The first person to make a principle of title-term indexing realized its weakness. Crestadoro in his Manchester Catalog, a concordance of titles, warns his users that in using the catalog some "relevant" items will be missed: "under any given subject the whole of the books . . . are not brought together, but only those in which the name of the subject occurs in the title."[1] Of course, Metcalfe regards the weakness as fatal and insists that title-term indexing is a delusion, which, while he can understand why it may have arisen, he fails to see why it persists.[1] It perhaps has as much reason for persisting as "specific" indexing. Either indexing seems adequate for retrieval situations in which completeness of recall is not necessary, or, for economic reasons, not possible. Situations where not all relevant documents on a subject are needed allow for compromise -- the number of documents that can be retrieved on a title basis may be all that is required.

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[1] Cleverdon and Keen, Factors Determining the Performance of Indexing Systems, Vol. 2, 259.

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[1] Quoted in Metcalfe, Information Indexing, p. 48.

The fact that the "weakness" of title-term indexing is its lack of depth raises the question whether there is an optimal average depth (or breadth) of indexing. The data seems to warrant the opinion that, for the most part, the deletion of terms from documents affects retrieval performance adversely. This seems especially true when performance is measured in terms of esl. It might be said to be qualifiedly true when the precision-recall measure is used, in the sense that the better results obtained by the deletion of terms are not always credible since they occur at high cutoff levels where the sample size is usually small. One might hypothesize that the indexing of documents should be as deep (broad) as possible, and examine the hypothesis for its plausibility.

To support the hypothesis an example can be given, illustrating that even the addition of a synonomous term to the indexing of a document could improve retrieval performance. Let $s^* = 3$ and assume the following two-level ordering, the first (case 1) having the document indexed without the synonomous term, case 2 with the synonomous term:

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[1] *Ibid.*, p. 49.

2 overlaps   Case 1 00●0●
1 overlap   00000●   Case 2 ●0●0●0
00000

Assume also that the question, either by the user or by the system via a thesaurus, is indexed with the two synonomous terms. In this case then the addition of the synonomous term to the document indexing has the effect of giving a relevant document an additional overlap with the question (case 2). Esl in the second case is 2.25; in the first case, before the addition of the synonomous term, it is 7.5. However, theoretically it can be argued that there is an upper limit on this redundancy effect, i.e., there is an upper limit to the number of terms which optimally should be assigned to a document. One can imagine an extreme case where the indexing is as deep as vocabulary size permits, where each document is indexed by every term on the indexing vocabulary. In this extreme and limiting case the document collection would be as unstructured and disordered as had there been no index terms assigned at all. In either case the collection would be searched for relevant documents, as though at random, the only difference being that in the one case all documents are collected at the highest overlap category and in the other at the 0 overlap category. Neither way is the indexing discriminating or informative. It is possible then, to index so deeply as to get no information at all about which documents are relevant to which questions. Hypothetically at least, esl need not increase with the deletion of index terms. On the other hand, though the point of effective redundancy in indexing can be over-reached,[1] it would seem that the content of the documents being indexed, as well as language itself, would set a natural limit on possible redundancy far below this limit.

The operational imperative suggested by the foregoing is to index as deeply as semantic meaning will allow. But this is speculation only. Nothing in the experiment really justifies a statement about an upper depth limit, since the experiment was restricted by the number of terms originally assigned to the documents (on the average 35). It might be suggested that the experimental results indicate a practical limit to indexing depth, in the sense of diminishing returns; if the deletion of terms does not give performance values which are significantly worse, the cost of assigning these terms at the time of the original indexing is not really justified. The esl results show that for any size request at least one quartile of the index terms assigned to documents do not contribute significantly to effective retrieval. Unfortunately it is not always the same 25% of the postings which are superfluous.

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[1] The question about the amount of redundancy needed in indexing can be regarded as a question about the distribution of index terms. In the literature it has been suggested that the most informative distribution of index terms is the one that makes for the most uncertainty about the number of postings any given terms will have (see Pranas Zunde and Vladimir Slamecka, "Distribution of Indexing Terms for Maximum Efficiency of Information Transmission," American Documentation, XVIII, (April 1967), 104). It is not clear. In fact, it is unlikely that semantics can be so easily dismissed. Perhaps the truest thing that can be said is only tautological: what makes indexing informative is its discriminating power, its ability to structure the collection in such a way that it is easier to retrieve relevant documents than irrelevant ones. Conceivably the collection should be structured differently depending on whether requests for relevant documents are small or large. One might say, with regard to the example above, that of a single document request, that the structuring of the collection is overinformative, the high overlap levels being too rich in relevant documents so that esl could be improved by term deletion. It could be regarded as underinformative when the number of documents requested is much larger than the number retrieved at any overlap level above 0. In any case it does not seem that optimal or normative index term distribution can be discovered by statistical information theory (Zunde and Slamecka) or, for that matter, by a descriptive or mathematical analysis of how index terms are actually distributed (Wall). In some manner questions about the depth, breadth and distribution of index terms must be related to measures of retrieval effectiveness.

Practical Implications

Library practice over the years has attempted to reach a compromise between good precision and good recall. It will be remembered that it was the lack of precision in retrieval output that first title-term indexing and then the alphabetical catalog with its specific entry principle was intended to remedy. Consciously and perhaps unconsciously there has been an unwillingness to compromise. Unconsciously in that there seems to be an attempt to obey two conflicting imperatives: to bring all books on a subject together[1] (recall) and to index as specifically as possible (precision). One can read this conflict in the history of the controversy over alphabetical and classified catalogs. Unwillingness to compromise is also represented in the conscious opposition to the principle of double entry,[2] of having both broad and narrow terms to serve both sorts of users, those wishing completeness, and those needing only a few relevant documents. The main argument against using double entries has been that the catalog would be burgeoned with an unwieldy reference apparatus disproportionate to the number of actual items processed. A more persuasive argument against,perhaps,is the cost and time required by comprehensive indexing, when budgets and personnel are limited.

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[1] See for instance Metcalfe, Information Indexing, p. 48.

[2] See the discussion beginning on p. 19.

A corollary result of the precision-recall evaluation of broad and narrow terms is that a method is given for determining the relative effectiveness of the two precision devices: raising the cutoff point and deleting broad terms. For the collection studied, raising the cutoff point (making the search more exhaustive) is more effective until cutoff 3 is reached, at which point the best means to precision is to delete the broadest terms assigned to the documents (making the search more specific). This is an interesting result and if generalizable could have practical implications for libraries of the future. Ideally libraries should be able to accommodate request of any recall-precision requirement; in terms of esl, requests of any size. Documents should be indexed with broad terms to satisfy recall preferences, with narrow terms to satisfy precision preferences. It has been suggested[1] that indexing with narrow terms (as specifically as possible) would be sufficient, since one can always "explode" on these terms -- presumably via a thesaurus or classified schedule be led to the appropriate broad terms quite automatically. This perhaps shows an overassuming confidence in the simplicity of language structure as represented in thesauri. In any case it requires less assumption about the exploding possibilities in language to say that documents should be indexed with broad and narrow terms, and as deeply as possible up to the limit imposed by semantic common sense. It need not be said of an index language that it is too exhaustive, that there are too many "concepts" indexed; or that it is too specific -- in an ideal system at least, a narrow term does not preclude a broad term also being assigned. If retrieval values should be poor, it can always be argued that the fault lies not in the indexing but in the search strategy used. An ideal system allows the possibility of custom retrieval, of indexing that can be adjusted to every user's need, simply by varying search strategy. From the point of view of precision-recall, a search can be varied by deleting broad or narrow terms, or by changing the cutoff condition required by retrieval. The operating curves of a system prescribe a search strategy for each individual user, once he has decided on the particular balance he wishes maintained between precision and recall. From the point of view of esl, this balance is, in effect, achieved by specifying the number of relevant documents requested of the system -- this is part of "search strategy." In either case, whether the effectiveness of a retrieval system is measured in terms of precision-recall or esl, it would seem that, ideally at least, the best indexing is an indexing which is potentially all possible indexings and which, as part of a clearly explicated search strategy, is realized as a particular indexing, broad or narrow, as the case requires. Thus, it is not a question of deciding in the abstract which method of indexing is "best," but of giving the user at the time of search the option of tailoring the indexing to his needs.

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[1] See F.W. Lancaster, "MEDLARS: Report on the Evaluation of Its Operating Efficiency," American Documentation, XX, (April 1969), 131.

Indexing as deeply and broadly as document content permits is perhaps rather much of a theoretical luxury. From the point of view of traditional indexing practices it would be out of the question. Indexing depth, where specified at all, has been determined not by theoretical considerations but by policies dictated by cost and the practicality of catalog size. It is not likely that economic problems will vanish. Conceivably, automatic indexing procedures will be developed that will make the ideal of comprehensive indexing realizable. There are difficult problems in this area, however: problems in semantics, similar to those besetting mechanical translation, and problems in the technology of developing optical scanning devices. The old question of burgeoning a catalog with too many entries can be reformulated as a question of burgeoning a computer memory. Problems of file structure and search codes are exceedingly complex and mind-boggling. It would be surprising, for instance, if an optimum file structure (ordering of entries) is less elusive a goal than a single optimum breadth or depth of indexing. Ideally, entries in a file should be ordered differently for each request to make possible a systematic search for relevant documents. The number of entries in a file such as the catalog of a large university library can easily run into the millions. As yet it is economically unthinkable that all entries in this file could be weakly ordered according to overlap each time a new question is to be searched. It rather seems as though it will be awhile before the time is ripe for personalized retrieval, in which case the need for compromise still exists. The present study, while it suggests an operational rule for specification indexing for ideal libraries of the future, is not in itself sufficient to deal with the present and real problem of compromise which faces libraries today. What is needed in addition to such a study is information about user preference, for example a preference for precision over recall (or vice-versa); or, in the case of esl, a preference expressed in terms of the number of documents needed to satisfy a request. The difficulty here is in trying to approximate what perhaps does not exist, viz., a typical or average request for information.

Summary

By way of conclusion, certain limitations of the present study can be mentioned. They have been referred to in the text, and can be expressed here in the form of unknowns: 1) not knowing the effect on retrieval performance of the subject matter of the test collection, p. 73; 2) not knowing whether the sample size is large enough or sufficiently random to yield generalizable results, p. 78; 3) not knowing, with statistical certainty, the behavior of precision at high coordination levels, p. 99; 4) not knowing whether the coordination between questions and the titles of documents relevant to these questions reflects a bias one might expect to find in actual non-experimental retrieval situations, p. 121 ff.; 5) not knowing what a "typical" question or search request is, p. 137.

It might be said that to a certain extent the experimental results are circular in nature. The specificity or breadth of a term is defined as the number of documents indexed by the term; and retrieval effectiveness is evaluated with respect to the number of relevant documents a user wants or the number of irrelevant ones he will tolerate. There are, however, certain findings of the experiment that are not obvious: 1) deleting narrow terms never improves precision -- a counterinstance to the tradeoff hypothesis, in that deleting narrow terms can make both precision and recall worse; 2) the dichotomy between improving precision by indexing with narrow terms or by using broad terms and raising the cutoff point is a false one -- narrow terms are more effective as retrieval hooks at high cutoff levels than they are at low levels where, in fact, they are redundant; 3) the deletion of broad terms is in some instances a better means for improving precision than raising the cutoff point.

The significance of the present study lies in its being an attempt to use objective criteria for evaluating the "goodness" of indexing in terms of its specificity. Specificity, as a factor in indexing, has been considered important since the middle of the last century, yet till now there has been only speculation, combined though with firm conviction, about its certain usefulness and uncertain meaning. The designing of the experiment to study the effect of varying levels of specificity on retrieval performance has forced an explicit definition of "specificity" and has required an examination of specificity in its interrelatedness with other factors affecting retrieval performance. I would like to regard the study more as a method of historical and experimental analysis than as an attempt to provide operational answers -- it would have been surprising if there were easy answers. Qualifiedly then, the findings of the experiment may be summarized the following way:

1. The amount of material retrieved in a system is not a simple function of the total number of terms posted to documents in the collection. This is perhaps obvious, but it is useful in explaining why the quantity and quality of retrieval can vary considerably for collections having the same number of total term postings, in effect the same average indexing depth. Important also is the number of different terms posted. This is evidenced by the results for indexings of like depth that show different retrieval behavior depending on how terms were deleted from documents: whether many infrequent terms were deleted or a few broad terms were deleted.

2. At high cutoff values the retrieval power of broad and narrow terms tends to become equalized. The stricter retrieval condition at high cutoffs -- eg., a document must have five overlaps in common with a document to be considered "retrieved" -- has the effect of constraining the amount of material any single term,

especially broad terms, can retrieve. Where the cooperative strength of several terms is required for retrieval, the existence of narrow terms on documents becomes important. On the other hand, at low cutoff values, narrow terms appear to be redundant in that the broad terms cover so many documents -- eg., flow which indexes 75% of the collection -- it is unlikely that a narrow or infrequently used term could bring in something new.

3. At higher coordination levels, i.e., when precision is desired, narrow indexing is preferable to broad indexing. At these levels the removal of broad terms from the document indexing improves the quality of the retrieval output as seen from the operating curves for the various indexings, while the removal of narrow terms affects both recall and precision adversely. At lower coordination levels, i.e., where recall is maximized, the amount of retrieved material is so overwhelming that narrow terms are redundant and insignificant in effect. The removal of broad terms, while stemming the flood, is not as effective a measure for reducing the amount of irrelevant material retrieved as raising the cutoff point. What is most obvious in the data is that optimal breadth (and optimal depth as well) seem to be variables depending on cutoff point, ultimately on users' preference for precision or recall.

4. The deletion of index terms from documents generally impairs retrieval performance when measured by esl. On the whole relatively broad terms, terms occurring in the 2nd quartile (those posted 13 to 32 times), have the most power to retrieve

relevant documents, as measured by the increase in esl when these terms are deleted from the indexing. Fourth quartile terms, those used most infrequently, are not especially effective in retrieving relevant documents and for requests for more than one document they can be dispensed with without causing significantly lower esl values. The broadest terms are important retrieval hooks when the number of documents requested by the user is fairly large; they are not significantly important when the number of documents requested is small. As was seen in the case of precision and recall, what is "optimally" the best breadth of term is a variable -- it varies with cutoff point and the user's decision as to how much irrelevancy he can tolerate. When retrieval effectiveness is measured in terms of esl, optimal breadth varies according to the number of relevant documents the user wishes to retrieve from the system.

5. The operating curves for precision-recall show the relative usefulness of the two devices for improving precision: raising the cutoff point and deleting broad terms. This is presumably something that will differ from collection to collection. For the Cranfield II data, raising the cutoff is a better method for reducing the amount of irrelevant material retrieved until a cutoff of 3 is reached. After this "critical value," the more efficient method for improving precision is to delete broad terms.

6. The results for highly weighted indexing are disappointing. Indexing with the subset of weighted-10 index terms, those judged most highly descriptive of the text, resulted in significantly poorer retrieval performance than indexing with the full

set of originally assigned terms. This was true for performance measured in terms of precision-recall at low cutoff points and when the esl measure was used, for all s* values. Moreover, indexing with weighted-10 terms differed insignificantly, in retrieval results produced, from indexing with a subset of the same number of terms chosen at random from the original indexing. In fact, it appeared that better retrieval performance could be achieved by mechanically deleting the most frequent terms from the original set of terms than by conscientiously selecting out seemingly "unimportant" terms. However, a conclusion that a policy of weighting terms is not efficient should be suspended; it is possible that the fault is peculiar to this experiment and lies in the Cranfield II rules for weighting terms, especially the rule that says broad and vague terms should be excluded from the highest weight category.

7. The results for title-term indexing are less inconclusive. At high cutoff or low s* values, indexing with seven terms taken from the title of a document resulted in retrieval performance not significantly different from that obtainable from the original document indexing consisting of five times that many terms. Moreover, there was a significant difference in performance between indexing with the same number of terms chosen randomly from the originally assigned terms. On the other hand, the limits of title-term indexing are realized in those cases where user requests are for many documents, at the high recall region of the precision-recall operating curve, at high values of s*. The title-term results, thus, qualifiedly support the hypothesis that two indexings of

comparable breadth or depth differ in retrieval effectiveness because one consists of quality terms and the other does not.

APPENDIX A

COMPLETE VOCABULARY LIST

01	abel
00	aberration
00	ablated
01	ablating
04	ablation
00	able
01	about
01	above
01	abrupt
00	absence
01	absolute
00	absorbed
01	absorption
01	accelerated
01	accelerating
05	acceleration
00	accelerators
00	accelerometer
00	acceptance
00	accidental
01	accommodation
00	accumulation
00	accuracy
01	accurate
00	acetate
00	ackeret
01	acoustic
00	acoustically
00	across
00	acting
00	action
00	activation
01	active
01	activity
01	actual
01	addition
00	additional
03	adiabatic
02	adjacent
01	adjustable
00	adjusting
00	adsorption
00	advance
00	advancing
01	adverse
00	aeolotropic

37	aerodynamic
00	aerodynamically
00	aerodynamics
00	aeroelastic
01	aeroelasticity
16	aerofoil
00	aeronautical
01	aeroplane
00	aerothermochemistry
01	aerothermodynamic
00	aerothermoelastic
00	affected
00	aft
00	after
06	afterbody
00	afterburner
00	afterburning
00	aftercooler
00	afterflow
02	ahead
01	aileron
32	air
04	aircraft
00	aircraftresearch-association
00	airflow
00	airframe
00	airjet
00	airliner
00	airload
01	airspeed
00	airstream
00	airy
00	alclad
00	alcoa
00	alden
00	alfven
00	algebraic
00	algorithm
00	aligned
00	alignment
00	all
01	allmovable
00	allmoving
00	allowable
01	alloy
00	almen
00	alone
00	along
00	alteration
01	alternating
00	alternative
16	altitude
01	aluminum
03	ambient

00	ames
00	ammonium
02	amount
00	amplification
01	amplitude
00	analogous
00	analogue
01	analogy
00	analyser
19	analysis
03	analytic
06	analytical
01	anemometer
46	angle
00	angled
00	angular
00	angularly
00	anhedral
00	anisotropy
00	annular
01	annulus
00	antenna
00	anticlastic
01	antisymmetric
00	antisymmetrical
01	apex
02	apogee
01	apparatus
01	apparent
01	appearance
00	applicability
00	application
02	applied
01	approach
01	approaching
00	appropriate
09	approximate
00	approximating
11	approximation
00	ar
08	arbitrary
06	arc
01	ardc
03	area
01	argon
00	around
01	arrangement
00	arrest
01	arrow
00	art
02	artificial
00	artificially
00	asbestos
00	ascending
00	ascent
00	asme

20	aspect
00	assessment
01	associated
00	assumed
00	assuming
00	assumption
00	astrolite
00	astrophysics
01	asymmetric
00	asymmetrical
00	asymptote
06	asymptotic
00	asymptotically
01	atlas
21	atmosphere
06	atmospheric
01	atom
02	atomic
04	attached
02	attachment
29	attack
00	attenuating
02	attenuation
00	attitude
00	audio
02	augmentation
00	aural
00	auto
00	autocorrelation
00	autocorrelogram
00	autoignition
01	automatic
01	autopilot
00	auxiliary
02	average
00	averaging
00	avoidance
01	avro
12	axial
01	axially
06	axis
06	axisymmetric
00	axisymmetrical
01	back
00	backing
00	backward
01	baffles
00	bakanov
00	bakelite
03	balance
00	ball
02	ballistic
01	ballotini
01	balsa

01	bands
00	bandwidth
01	bangbang
00	bank
00	banked
00	bar
00	bare
00	barrel
06	base
00	based
01	basic
00	batdorf
00	bays
01	bead
02	beam
00	beane
00	bearing
00	beat
00	bed
00	bedford
00	beginning
04	behavior
06	behind
00	bei
00	bell
00	belleville
00	belotserkovski
01	belt

00	bend
08	bending
01	beneath
00	ber
00	bernoulli
00	berthelot
00	bessel
00	bestfit
00	beta
02	between
00	bevelled
00	bibliography
00	biconvex
00	bifurcation
00	biharmonic
00	billowing
00	bimetallic
00	bimolecular
00	binary
00	binding
01	biot
01	biplane
01	birnbaum
00	bisector
00	bistable
00	black
13	blade

03	blading
04	blasius
00	blast
02	bleed
00	bleeding
00	block
05	blockage
00	blocking
03	blow
02	blowdown
01	blower
05	blowing
01	blown
00	blowoff
00	blowout
01	bluff
27	blunt
06	blunted
01	blunting
03	bluntness
03	boattail
00	boattailed
00	boattailing
44	body
00	boiloff
00	bolt
00	boltzmann
00	bomb
00	bomber
00	bond
00	boom
01	boost
00	booosted
00	booster
00	boosting
00	bore
00	bottom
00	boultonpaul
01	bound
73	boundary
00	bounded
00	bounding
06	bow
00	bowing
00	box
00	boxtype
01	brading
00	braking
00	brass
00	breakdown
00	breaking
01	breathing
00	bridge
00	broad

00	btu
00	bubble
00	buckle
00	buckled
01	buckling
00	budiansky
01	buffet
05	buffeting
00	built
00	bulk
00	bulkhead
02	bump
01	buoyancy
02	burned
00	burning
00	buried
00	burst
01	bursting
00	busemann
02	buzz
00	cabin
00	calculated
01	calculating
39	calculation
00	calculus
00	calibrated
00	calibration
00	caloric
00	calorically
04	camber
01	cambered
00	camera
00	can
00	canard
00	cancellation
00	canted
01	cantelever
01	cantelevered
00	cap
01	capability
01	capacitance
01	capacity
00	capillary
00	capped
00	capsule
01	capture
00	caravelle
02	carbon
00	carbonate
01	carborundum
00	caret
01	carrying
02	cascade
00	case
00	cassinian
00	castiellanos

00	castolite
00	catalytic
00	cathode
00	cauchy
00	caused
00	cavitating
00	cavitation
00	cavity
00	cell
00	cellular
00	cellulose
00	centaur
01	centering
01	centimetre
01	central
00	centrally
14	centre
00	centred
00	centreline
05	centrifugal
00	centripetal
00	ceramic
01	cessation
02	chamber
08	change
00	changing
05	channel
00	chapman
15	characteristic
00	charge
01	charged
00	charging
00	chart
04	chemical
03	chemically
00	chemisorption
00	cheng
00	chessboard
00	chien
00	chimneys
00	china
01	chloride
01	choke
05	choked
05	choking
07	chord
12	chordwise
00	chroming
00	chromium
00	cincinnatitestinglaboratorymaterial
00	circling
01	circuit
00	circuitry
18	circular
00	circularity

01	circulating
03	circulation
01	circulatory
01	circumferential
00	circumscribed
00	civil
00	clamped
00	clamping
00	clamshell
01	classical
00	classification
00	clausing
00	clay
00	climb
01	clipped
00	clockwise
00	close
03	closed
00	closely
00	closures
00	cloud
00	coaxial
01	cocurrent
00	code
50	coefficient
02	cold
00	cole
00	collapse
00	collapsing
00	collecting
00	collective
02	collision
00	collocation
00	columbium
00	column
02	combination
03	combined
00	combustible
03	combustion
00	comparison
00	compatibility
00	competition
00	complementary
05	complete
00	completion
00	complex
02	component
01	composed
01	composite
01	composition
01	compound
01	compreg
01	compressed
04	compressibility

16	compressible
00	compressing
05	compression
00	compressive
00	compressively
11	compressor
01	computation
00	computational
00	compute
03	computer
02	concave
01	concentrated
01	concentration
01	concentric
00	concept
00	conceptual
01	condensation
21	condition
01	conducting
08	conduction
00	conductive
04	conductivity
00	conductor
11	cone
00	coned
07	configuration
00	confluence
00	confluent
00	conformal
09	conical
01	conically
00	conjugate
00	connected
01	conservation
00	conservativeness
00	considerations
00	consistent
12	constant
01	constraint
00	constriction
03	construction
00	consumption
01	contact
00	containment
00	contamination
00	content
01	continuation
01	continuity
05	continuous
00	continuously
03	continuum
03	contour
00	contoured
01	contracting
06	contraction

01	contribution
20	control
00	controlled
01	controlling
00	convected
00	convecting
04	convection
04	convective
00	conventional
03	convergence
04	convergent
03	converging
00	conversion
00	convertor
03	convex
00	cool
00	coolant
01	cooled
00	cooler
04	cooling
03	coordinate
00	coplanar
02	copper
00	core
04	corner
00	cornered
01	corotating
05	correction
00	corrective
00	corrector
01	correlated
00	correlation
00	correlator
00	correlogram
00	corresponding
00	corridor
00	corrugated
00	corrugation
00	cost
02	couette
00	coulomb
00	counter
00	counteraction
01	countercurrent
01	counterrotating
00	counting
00	couple
01	coupled
00	coupling
01	coupon
00	cover
00	coverage
00	covered
00	cowling

00	crack
00	cracking
00	crank
00	creep
00	creeping
00	crest
01	criterion
02	critical
00	crocco
00	crookedness
01	cropped
05	cross
01	crossection
01	crossed
01	crossflow
01	crossing
00	crown
00	cruciform
00	cruise
01	cruising
00	crystals
00	cubic
00	cumulative
00	curling
01	current
00	curtain
00	curtis
00	curtisswright
11	curvature
08	curve
02	curved
00	curvilinear
00	cushion
00	cusp
00	cusped
00	cut
00	cutout
01	cycles
00	cyclic
00	cycling
00	cyclotron
17	cylinder
03	cylindrical
00	d-c
00	damage
00	damped
13	damping
01	dampometer
00	dashpot
12	data
00	day
01	daytime

01	daytonight
00	dead
00	debris
00	debye
00	decarburized
03	decay
01	decaying
01	decelerating
04	deceleration
00	deck
00	decomposition
00	decoupling
01	decrease
00	decreasing
00	decrement
00	deduction
00	deexcitation
00	defect
01	deficiency
00	deficit
00	deflagration
02	deflected
00	deflecting
05	deflection
00	deformable
00	deformation
00	deformed
00	deforming
00	degeneration
18	degree
00	dehoffman
00	delaval
01	delay
12	delta
00	dense
24	density
00	dependant
00	dependence
05	dependent
00	deposit
00	deposited
00	depression
00	depth
01	derivation
09	derivative
00	deryagin
00	descending
00	descent
00	description
00	descriptive
15	design
01	destabilising
00	destalling
04	detached

05	detachment
00	detection
13	determination
00	detonation
00	deuce
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03	piston
07	pitch
21	pitching
01	pitchup
00	pitometer
00	pitot
02	pivot
02	pivotal
00	plain
00	planar
00	planck
08	plane
01	planet
06	planetary
00	planetocentric
08	planform
00	plant
00	plaskon
00	plasma
01	plastic
00	plasticity
27	plate
00	plateau
02	plates
00	plating
00	plenum
00	plexiglass
00	plk
00	plot
03	plotting
00	plug
00	plume

01	plunging
00	plywood
00	pneumatic
00	pocket
00	poggi
00	pohle
02	pohlhausen
00	poincare
27	point
01	pointed
01	poiseuille
00	poisson
01	polar
00	pole
00	polished
00	polyatomic
00	polyaxial
00	polycrystalline
00	polyester
01	polygon
00	polygonal
01	polymer
00	polynomial
00	polystyrene
00	pondermotive
00	porous
01	portion
09	position
00	positioning
01	positive
01	possion
00	post
01	postbuckling
00	potassium
13	potential
00	potentiometer
01	pound
01	powell
04	power
00	powered
00	powerplant
01	practical
05	prandtl
00	preasymptotic
00	prebuckled
00	prebuckling
00	precession
Oo	precipitation
15	prediction
00	preferential
00	preliminary
00	preloading
00	premixed
00	prerotation
02	prescribed
00	presence

98	pressure
00	pressurization
00	pressurized
00	preston
00	prevented
00	prevention
02	prewhirl
02	primary
01	principle
00	prior
00	prismatic
00	probability
04	probe
08	problem
00	probstein
01	procedure
02	process
00	processed
01	product
01	production
19	profile
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00	programmed
00	programming
02	progressive
00	projected
00	projectile
01	projection
01	prolate
00	promoter
01	promotion
00	proof
01	propagating
01	propagation
02	propellants
01	propelled
02	propeller
07	property
00	proportion
00	proportional
02	propulsion
04	propulsive
01	protection
00	proton
00	protuberance
00	proturbulence
00	providing
01	proximity
00	pspp.
00	pseudo
00	pulse
02	pump
01	pure
00	pyramidal
00	quadrature
00	quadrupole

00	qualitative
01	quality
00	quantitative
00	quantity
00	quarter
00	quartic
01	quartz
02	quasi
00	quasicircular
02	quasiconical
00	quasicylinder
00	quasicylindrical
00	quasiequilibrium
00	quasionedimensional
00	quasisteady
00	quasiunsteady
00	quenching
00	quick
00	rabotnov
00	radar
04	radial
00	radially
00	radiant
00	radiating
08	radiation
02	radiative
01	radiator
01	radioactive
00	radiotrajectograph
03	radius
03	rae
00	rakes
00	ramberg
01	ramp
02	random
09	range
01	rankine
00	raphson
00	rapid
00	rarefaction
02	rarefied
22	rate
61	ratio
01	raw
00	ray
00	raybestos
03	rayleigh
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10	reaction
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00	reactor
00	reading
04	real
05	rear
01	rearward
00	reattached

00	reattaching
03	reattachment
00	receiver
02	reciprocal
00	reciprocity
00	recirculating
03	recombination
00	recompression
01	record
00	recording
00	recoverable
03	recovery
00	rectangle
10	rectangular
00	rectilinear
00	redirecting
00	redistribution
01	reduced
01	reducted
10	reduction
00	redundant
00	reentering
01	reentrant
15	reentry
00	reestablishment
01	reference
00	refinement
03	reflected
00	reflecting
06	reflection
00	refraction
00	refractory
00	refrasil
03	regime
09	region
01	regression
00	regular
00	regulation
00	reimpingement
00	reinforced
00	reissner
09	relation
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05	relative
00	relatively
00	relativistic
07	relaxation
00	relaxational
00	relaxing
01	relay
01	release
01	reliability
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02	removal
01	removed
00	reorbit

00	replacement
00	replenishment
00	representation
00	required
03	requirement
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01	reservoir
00	residual
00	residue
00	resin
01	resistance
00	resisted
00	resisting
00	resolidification
00	resolution
02	resonance
01	resonant
04	response
01	rest
01	restart
00	resting
00	restoring
00	restrained
00	restraining
00	restraint
00	restricted
07	result
01	resultant
00	resulting
00	retardation
00	retarded
01	retarding
02	retrorocket
00	return
00	reuse
03	reversal
00	reverse
01	reversed
01	reversibility
00	review
00	revised
13	revolution
00	rex
27	reynolds
00	rf
00	rheological
00	rhombic
00	rib
00	ribbon
00	riccatti
02	richardson
00	ridge
01	riemann
00	right
06	rigid
01	rigidity
01	rigidly
00	rim

00	ring
00	ripple
09	rise
00	ritz
00	rivet
00	rms
14	rocket
00	rocketon
01	rod
02	roll
00	rolled
04	rolling
00	roof
01	rooftop
01	room
03	root
02	rotary
07	rotating
04	rotation
06	rotational
00	rotatory
03	rotor
00	rough
03	roughness
00	round
01	rounded
00	rounding
01	roundingoff
00	roundness
01	routine
00	routt
01	routthurwitz
02	row
00	rubber
01	rudder
01	rule
01	running
00	rupture
00	sae
01	safety
01	sail
01	salt
00	sample
00	sampling
00	sand
01	sandpaper
00	sandwich
13	satellite
01	saturation
00	saturn
00	saundersroe
00	saving
07	scale
01	scaling
00	scattering
01	scavenging

00	schindel
01	schlichting
04	schlieren
00	schmidt
00	schubauer
00	scoop
00	scooped
00	scooping
00	screen
00	screw
00	sea
00	seal
00	sealing
00	scars
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01	seasonal
00	secant
02	second
01	secondary
02	secondorder
23	section
02	sectional
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00	sectorial
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01	seeded
04	segment
00	segmentation
00	segmented
00	seide
01	selected
01	self
01	selfinduced
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00	semiapex
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00	semicircular
01	semiellipsoid
00	semiellipsoidal
00	semiempirical
03	semiinfinite
00	semiinverse
03	semimajor
00	seminumerical
00	semirarefied
00	semirigid
00	semispan
01	semivertex
00	sensitivity
01	sensor
04	separated
00	separating
27	separation
00	sequential
03	series
01	servo
00	set

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00	settling
00	seventh
01	severe
01	severely
00	sextic
02	shadowgraph
00	shaft
00	shakedown
00	shallow
00	shallowness
00	shank
00	shanley
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14	sharp
00	sharpness
06	shear
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00	shearing
00	sheath
00	shedding
02	sheet
00	shell
00	shesterikov
02	shield
00	shielded
01	shielding
00	shift
00	ship
44	shock
00	shocking
00	shockless
01	short
00	shortening
04	shroud
00	shrouded
00	shuffle
00	sicromog
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00	sidedness
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01	sidewash
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01	similarity
01	similitude
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00	simplified

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00	singularity
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03	sinusoidal
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00	sixth
08	size
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18	skin
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01	slipstream
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03	slot
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00	smoothness
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01	soft
04	solar
10	solid
43	solution
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03	source
00	southwell
05	space
00	spacecraft
00	spaced
00	spaceship
02	spacing
10	span
01	spanning
12	spanwise
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00	spark
00	sparrow
00	spatial
01	species
08	specific
01	specimen
02	spectra
00	spectral
00	spectrography
01	spectrum
00	specular
28	speed
03	sphere
07	spherical
02	spherically
01	spheroid
01	spike
01	spiked
01	spin
00	spinner
00	spinning
00	spiral
00	spiralling
00	split
01	splitter
01	spoiler
00	spot
00	spray
00	spread
00	spreading
00	spring
00	spruce
03	sputnik
01	square
00	squires

00	srn
18	stability
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00	stabilized
00	stabilizer
00	stabilizing
02	stable
02	stacking
04	stage
01	stagger
01	staggered
00	staggering
00	stagnant
32	stagnation
00	stainless
06	stall
02	stalled
03	stalling
00	stalmach
00	stand
01	standard
00	standing
06	standoff
00	stanton
00	start
02	starting
04	state
21	static
01	statically
00	station
03	stationary
01	statistical
00	statistics
01	stator
17	steady
00	steam
01	steel
00	steep
00	steepest
00	stefan
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01	step
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00	stepdown
00	stepwise
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01	stiffener
00	stiffening
08	stiffness
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01	stores
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01	stratford
00	stratiform
28	stream
09	streamline
01	streamtube
03	streamwise
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07	stress
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05	structure
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05	study
00	stvenant
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00	subaudio
00	subcritical
00	subject
01	subjected
00	sublayer
03	sublimination
00	submerged
31	subsonic
01	substantial
00	substitutes
03	successive
00	sucking
04	suction
01	sudden
00	sugar
01	sun
00	superaerodynamic
00	supercircular

00	supercritical
00	superfast
00	superimposed
02	superposition
01	supersatellite
57	supersonic
00	supersonically
00	supply
00	supplying
02	support
01	supported
01	supporting
00	suppression
55	surface
00	surfaced
04	surge
00	surrounding
05	survey
00	suspension
00	sustained
00	sustaining
00	sutherland
00	swallowing
00	sweat
07	sweep
03	sweepback
00	sweepforward
10	swept
13	sweptback
00	sweptforward
00	swirl
00	switching
02	symmetric
07	symmetrical
00	symmetrically
00	symmetry
00	synthesis
08	system
01	systematic
00	t
02	tab
04	table
01	tabulation
04	tail
01	tailboom
01	tailless
00	tailored
00	tailoring
01	tailplane
00	takeoff
00	tangency
01	tangent
03	tangential
00	tank
01	tap
03	taper

02	tapered
00	tapped
01	tapping
01	target
00	taxiing
01	taylor
02	technique
00	teeth
03	teflon
00	telegraph
01	telemetering
00	telemetry
00	television
00	teller
40	temperature
00	tending
00	tensile
02	tension
00	tensor
00	term
02	terminal
00	terminated
00	termwise
49	test
05	testing
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01	theodorsen
01	theorem
15	theoretical
42	theory
07	thermal
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00	thermochemical
00	thermocouple
03	thermodynamic
00	thermoelastic
00	thermold
00	thermomechanical
00	theta
06	thick
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02	thickening
23	thickness
09	thin
00	third
00	thorable
01	three
12	threedimensional
00	threedimensionality
03	threepoint
00	threshold
04	throat
00	throttle
02	through
12	thrust

01	thwaites
00	tilt
00	tilting
12	time
01	timeoptimum
00	timewise
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00	timkenrollerbearingco.
10	tip
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00	titanium
00	tnt
00	tolerance
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01	tollmienschlicht
00	tollmienschlichting
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00	torda
00	toriconical
00	torispherical
00	toroidal
01	torque
00	torsion
03	torsional
01	torso
00	torus
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00	towards
00	traces
00	tracing
00	tractions
00	trail
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05	trajectory
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00	transcendental
00	transducers
23	transfer
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03	transformation
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13	transition
04	transitional
02	translation
00	translational
00	translatory
00	transmission
22	transonic
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01	transpiration
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00	transversality

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01	traverse
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01	truncated
00	truss
00	tsien
11	tube
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01	tungsten
62	tunnel
00	turbine
04	turbojet
01	turbomachine
01	turbulence
16	turbulent
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01	turning
00	twin
03	twist
02	twisted
00	twisting
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35	twodimensional
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01	ultraviolet
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01	unbounded
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00	uncooled
01	uncoupled

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00	undisturbed
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01	unidirectional
00	unified
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00	uniformly
00	unimodal
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01	unity
00	univac
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00	unloading
00	unperturbed
00	unpowered
00	unpressurized
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01	unstalled
01	unstalling
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00	unsupported
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01	untapered
01	unwind
00	unwrinkled
00	unyawed
00	upflow
00	upload
13	upper
01	uprating
07	upstream
02	upwash
00	ur
00	use
00	v
01	vacuum

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03	value
01	valued
00	valve
00	vandriest
00	vandyke
04	vane
01	vaneless
01	vanguard
03	vanishing
00	vanishingly
01	vapour
01	vapourization
06	variable
17	variation
01	variational
00	varying
04	vector
19	vehicle
44	velocity
00	venting
01	venturis
00	venus
00	verification
00	vertex
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01	very
00	vessels
00	vibrating
06	vibration
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00	vibratory
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02	viscid
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00	viscoelasticity
00	viscoplastic
05	viscosity
23	viscous
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00	vision
00	visual
00	visualization
00	volterra
01	volume
00	volumetric
01	vonkarman
16	vortex
00	vortical
12	vorticity
00	voyage
00	vtol
00	w

01	wagner
00	waists
09	wake
00	wakelike
00	walkden
25	wall
00	walled
00	walles
01	ward
00	warhead
00	warp
00	warpage
00	warped
01	warren 12
00	washed
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00	waterproofing
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01	wavelength
00	waviness
00	wavy
00	weak
01	weakening
00	weapon
00	web
10	wedge
00	weierstrauss
10	weight
00	weighting
00	weinstein
01	weissinger
00	wetted
00	wetting
01	whirl
00	whitham
00	whole
02	wide
00	widely
04	width
55	wind
00	window
02	windward
59	wing
02	winged
00	wingless
03	wire
00	with
01	within
00	without
01	wood
00	work
05	working
00	woven
00	wrinkled
00	wrinkling

00	x
00	xenon
03	yaw
02	yawed
01	yawing
00	yield
00	young
00	yoyo
00	z
10	zero
00	zinc
02	zone
00	zoom

APPENDIX B

DOCUMENT INDEXING

1302	07	AIR	N	T	V		S
1302	06	ALTITUDE	N		V	M	
1302	08	APPROXIMATION	N	T	V		
1302	08	ATMOSPHERE	N		V	M	S
1302	05	BOUNDARY			V	M	S
1302	06	CLOSED					
1302	08	COEFFICIENT	N		V	M	S
1302	06	COLLISION			V	M	S
1302	07	COMPLETE			V		
1302	06	COMPONENT	N		V	M	S
1302	08	COMPRESSIBILITY	N		V		S
1302	08	CONDUCTIVITY	N		V	M	
1302	08	DEGREE			V		S
1302		DETERMINATION	N		V		S
1302	07	EFFECT	N		V		
1302	07	ENERGY			V	M	S
1302	08	ENTHALPY	N		V		S
1302	08	ENTROPY	N		V	M	S
1302	07	EQUILIBRIUM	N		V	M	S
1302	10	FAIR			V	M	S
1302	05	FLUX	N		V	M	S
1302	06	FORM	N				S
1302	07	FRACTION	N		V	M	S
1302	07	FULLY			V		S
1302	05	FUNCTION	N		V		S
1302	06	GAS			V		S
1302	08	HEAT	N		V		S
1302	10	HIGH		T	V		S
1302	07	IONIZED			V		S
1302	08	KELVIN	N		V	M	S
1302	06	KINETIC			V	M	S
1302	05	LAYER	N		V	M	S
1302	07	MOL			V		S
1302	07	NONEQUILIBRIUM			V		S
1302	08	NUMBER	N		V		S
1302	06	PARTICLE	N		V		SA
1302	05	PARTITION			V		S
1302	08	PRANDTL					S
1302	09	PROPERTY	N	T	V	M	S
1302	08	SOUND	N		V		S
1302	08	SPECIFIC			V		S
1302	08	SPEED	N		V		S
1302	10	TEMPERATURE	N	T	V	M	S
1302	06	THEORY	N		V	M	S
1302	08	THERMAL			V		S
1302	09	THERMODYNAMIC		T	V	M	S
1302	09	TRANSPORT		T	V		
1302	08	VISCOSITY	N		V		S
1311	07	BLUNT			V	M	S
1311	10	BOUNDARY	N			M	S
1311	10	BUFFET			V		S
1311	10	BUFFETING	N	T	V	M	S
1311	08	BUZZ	N		V		S
1311	07	COEFFICIENT			V		S
1311	09	DIVERGENCE	N		V		S

1311	10	EDGE	N		V	M	S
1311	05	EFFECT	N	T	V	M	
1311	06	FLIGHT	N		V		S
1311	07	FLOW	N		V		S
1311	07	FORWARD			V	M	
1311	08	INCIDENCE	N		V	M	S
1311	07	INCREASING			V	M	S
1311	09	INDUCED			V		S
1311	09	LAYER			V		S
1311	10	LEAD			V		S
1311	09	LEADING			V		S
1311	08	LIFT			V	M	S
1311	07	LOCATION	N		V		
1311	07	MACH	N		V	M	
1311	09	MODEL	N	T	V	M	S
1311	09	ONSET	N	T	V		S
1311	08	OUTBOARD	N		V	M	S
1311	07	POSITION			V	M	S
1311	09	PREDICTION	N	T	V	M	S
1311	09	PRESSURE			V	M	S
1311	09	REAR				M	S
1311	09	RIGID		T	V	M	
1311	06	SCALE			V		S
1311	09	SEPARATION	N	T	V	M	S
1311	09	SHOCK			V		S
1311	08	SPANWISE			V		S
1311	07	SPEED			V	M	S
1311	07	SUPERSONIC			V		S
1311	08	SWEPTBACK			V	M	S
1311	06	TAPPING	N		V	M	
1311	07	TEST	N	T	V	M	S
1311	10	TRAILING			V		
1311	09	TUNNEL	N	T	V	M	S
1311	10	UNSTEADY				M	S
1311	09	VARIATION			V		S
1311	08	VORTEX					
1311	08	WAKE				M	
1311	08	WAVE				M	
1311	07	WIDTH			V		S
1311	09	WIND		T		M	S
1311	09	WING	N		V	M	S
1316	07	AEROFOIL	N		V	M	
1316	09	BOUNDARY	N	T	V		S
1316	05	CHORDWISE			V	M	S
1316	05	COEFFICIENT			V	M	S
1316	06	DISPLACEMENT	N		V		S
1316	05	DISTRIBUTION	N		V		S
1316	08	DIVERGENT			V		S
1316		FLOW	N		V	M	S
1316	09	HIGH		T	V	M	S
1316	09	INCIDENCE	N	T	V	M	S
1316	09	LAYER		T	V		S
1316		LIFT	N		V		S
1316	07	MACH	N		V		S
1316	09	ONSET	N		V	M	S
1316	06	OUTFLOW	N		V		

1316	06	POSITION	N		V	M	S	
1316	07	PRESSURE	N		V	M	S	
1316	06	REATTACHMENT	N		V	M	S	
1316	06	RECOVERY	N		V	M	S	
1316	08	SECTION			V		S	
1316	06	SEPARATED			V			
1316	10	SEPARATION	N	T	V		S	
1316	08	SHAPE	N		V		S	
1316	06	SHOCK			V	M		
1316	05	SPANWISE			V	M		
1316	09	SPEED	N	T	V	M	S	A
1316	05	STEADY			V		S	
1316	07	SUBSONIC			V		S	
1316	07	SUPERSONIC				M	S	
1316	06	SURFACE			V		S	
1316	08	SWEPTBACK			V		S	
1316	06	THICKNESS	N		V	M	S	
1316	07	TWODIMENSIONAL			V			A
1316	06	UPPER			V		S	
1316	06	VORTICES	N		V		S	
1316	08	WING	N		V		S	
1317	07	AMOUNT			V	M	S	
1317	07	APPROXIMATION	N		V		S	
1317	10	BLUFF			V	M		
1317	09	BODY	N		V	M	S	
1317	08	BOW			V	M	S	
1317	07	DENSITY			V	M		
1317	10	DISSOCIATING		T	V		S	
1317	08	DISSOCIATION	N		V		S	
1317	08	EXCITATION	N				S	
1317	09	FLOW	N			M	S	
1317	09	GAS	N	T	V		S	
1317	10	IDEAL			V		S	
1317	07	INFINITESIMALLY			V		S	
1317	08	MODE	N		V		S	
1317	07	NEWTONIAN			V	M	S	
1317	08	NODE	N		V		S	
1317	10	NONEQUILIBRIUM		T		M	S	
1317	09	NORMAL			V	M	S	
1317	07	PASSING			V	M	S	
1317	07	POSITION	N			M	S	
1317	07	PREDICTION	N			M	S	
1317	07	PRESSURE			V		S	
1317	07	PROFILE	N		V	M	S	
1317	08	ROTATIONAL			V	M	S	
1317	10	SHOCK			V		S	
1317	10	SPHERE	N			M	S	
1317	08	STREAMLINE			V			
1317	07	TEMPERATURE			V	M	S	
1317	09	THEORY	N	T	V		S	
1317	07	THIN					S	
1317	07	VARIATION	N		V	M	S	
1317	08	VIBRATIONAL			V		S	
1317	10	WAVE	N		V	M		

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1320 09 ACCURATE                            V
1320 10 BLASIUS                           T V   S
1320 08 BLOWING                         N   V   S
1320 09 BOUNDARY                          T V M
1320 08 COCURRENT                           V
1320 09 CONDITION                       N T V     A
1320 07 FLAT                                V M S
1320 07 FLOW                            N   V M S
1320 08 JET                                 V
1320 07 LAMINAR                             V M
1320 07 LAYER                               V M S
1320 08 MIXING                          N   V   S
1320 09 NUMERICAL                         T   M S
1320 07 PLATE                           N   V M S
1320 09 PROBLEM                         N T V M S
1320 09 SOLUTION                        N T V M S
1320 08 STREAM                          N   V M S
1320 09 THREEPOINT                        T V
1321 06 ANALYTIC                            V M S
1321 10 BLASIUS                           T V M S
1321 09 BOUNDARY                          T V
1321 06 COMPUTER                        N   V M
1321 09 CONDITION                       N T V M SA
1321 09 CONSTANT                            V   S
1321 09 CONTINUATION                    N   V   S
1321 09 DISTRIBUTION                    N     M S
1321 09 FLOW                            N   V M S
1321 09 FLUID                               V M S
1321 09 JET                                 V M S
1321 09 LAMINAR                             V   S
1321 09 LAYER                               V M S
1321 09 MIXING                          N   V M S
1321 09 NUMERICAL                         T
1321 09 PRESSURE                            V   S
1321 10 PROBLEM                         N T V M S
1321 09 REST                            N   V M S
1321 09 SEPARATED                           V M
1321    SERIES                          N   V   S
1321 09 SOLUTION                        N T V   S
1321 09 STEADY                              V M S
1321 06 TAYLOR                              V M S
1321 09 THREEPOINT                        T V M
1321 09 TWODIMENSIONAL                      V M
1321 09 VELOCITY                            V   S
1321 09 WAKE                                V
1322 09 ASYMPTOTIC                          V
1322 10 BLASIUS                           T V
1322 09 BOUNDARY                          T V
1322 09 CONDITION                       N T   M SA
1322 08 FLUID                               V   S
1322 09 INTEGRATION                         V M
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1322	09	METHOD	N		V	M	
1322	08	MIXING	N		V	M	S
1322	09	PROBLEM	N	T	V	M	
1322	09	SOLUTION	N	T	V	M	S
1322	09	THREEPOINT		T	V		S
1324	07	AXISYMMETRIC			V	M	
1324	09	BOUNDARY			V		S
1324	06	CURVATURE	N		V	M	S
1324	06	CYLINDRICAL			V		S
1324	06	DISPLACEMENT	N		V	M	
1324	09	FLOW	N	T	V	M	S
1324	09	FLUID	N	T	V	M	S
1324	09	INCOMPRESSIBLE		T	V		
1324	05	INVISCID			V		S
1324	09	LAYER			V	M	S
1324	07	PLANE			V	M	
1324	09	POINT		T		M	S
1324	06	ROTATIONAL			V		S
1324	09	SHEAR	N		V	M	S
1324	05	SHOCK	N		V		S
1324	06	SLIP			V	M	S
1324	06	SPHERICAL					
1324	10	STAGNATION		T	V	M	
1324	06	THICKNESS	N		V		S
1324	07	THREEDIMENSIONAL			V	M	S
1324	07	TWODIMENSIONAL			V	M	S
1324	09	VISCOUS		T	V	M	
1324	10	VORTICITY	N	T	V	M	S
1335	10	ARC			V		S
1335	09	BOUNDARY		T			S
1335	10	CIRCULAR			V		S
1335	09	DISTRIBUTION	N		V	M	S
1335	08	EXPANSION			V		S
1335	09	FLOW	N	T		M	S
1335	10	INTERACTION	N	T	V		
1335	09	LAYER	N	T	V	M	
1335	10	PATTERN	N		V		S
1335	09	PRESSURE				M	S
1335	10	PROFILE	N				S
1335	08	REFLECTION	N				S
1335	09	SEPARATION	N		V	M	
1335	10	SHOCK		T	V		
1335	09	TEST	N		V	M	
1335	10	TRANSITION	N		V		S
1335	09	TRANSONIC		T	V	M	S
1335	09	TUNNEL			V	M	
1335	10	WAVE	N	T		M	
1335	09	WIND					S
1335	08	ZONE	N				S

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1351 08 CHANNEL          N   V   S
1351    CONSTANT               M S
1351 08 CONVERGING           V M S
1351 09 DISTRIBUTION     N T V M S
1351 08 DIVERGING            V
1351 09 EXACT                V M S
1351 09 FLOW             N T V M S
1351 09 FLUID            N   V
1351 08 HYDRODYNAMIC         V M S
1351 09 INCOMPRESSIBLE       V M S
1351 10 JEFFERYHAMEL       T V   S
1351 09 LAMINAR              V M S
1351 10 NONPARALLEL        T V
1351 10 PLANE                    S
1351 08 PRANDTL          N   V
1351 08 PROBLEM          N     M S
1351 07 PROFILE          N   V   S
1351 08 REYNOLDS         N   V M S
1351 09 THERMAL            T V M S
1351 08 THERMODYNAMIC        V M S
1351 07 VELOCITY             V
1351 09 VISCOUS              V   S
1351 10 WALL             N T   M S
1360 07 AERODYNAMIC          V   S
1360 10 AFTERBODY        N   V M S
1360 09 ANALYSIS         N   V   S
1360 09 ANGLE                V   S
1360 09 APPROXIMATION    N   V M S
1360 09 ATTACK           N       S
1360 08 BOATTAIL         N   V   S
1360 10 BODY               T V   S
1360 09 CENTRE                   S
1360 07 CENTRIFUGAL          V
1360 09 CIRCULAR             V M
1360 09 COEFFICIENT      N     M S
1360 09 CONE             N   V M S
1360 09 CYLINDER         N   V M S
1360 07 EXPANSION            V   S
1360 09 EXPERIMENTAL         V M S
1360 09 FLOW             N T V M S
1360 09 FORCE            N     M S
1360 09 HYPERSONIC         T V M S
1360 08 IMPACT               V   S
1360 10 LIFT             N T V   S
1360 09 MACH             N   V   S
1360 10 MISSILE          N   V   S
1360 09 MODERATE                 S
1360 08 NEWTONIAN            V   S
1360 09 NORMAL               V M S
1360 09 OGIVE            N     M S
1360 07 PREDICTION       N   V   S
1360 09 PRESSURE         N   V
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1360 07 REGION                         N   V M S
1360 09 RESULT                         N     M S
1360 10 REVOLUTION                     N T V
1360 09 SUPERSONIC                         V   S
1360 10 WINGED                             V M
1360 10 YAWED                              V M S
1367 07 BEHAVIOUR                      N   V M S
1367 08 CONTROL                          T V M
1367 05 DESIGN                         N T V M
1367 09 DYNAMIC                            V M S
1367 07 ESTIMATION                     N       S
1367 07 LINEAR                             V
1367 10 LYAPUNOV                       N T V M S
1367 09 METHOD                           T V
1367 07 NONLINEAR                          V M S
1367    NONSTATIONARY                      V   S
1367 07 OPTIMIZATION                   N     M S
1367 06 RELAY                              V   S
1367 09 SECOND                           T V M
1367 06 SERVO                          N   V
1367 10 STABILITY                      N   V   S
1367 07 STATIONARY                         V   S
1367 09 SYSTEM                         N T V M S
1367 09 THEORY                         N   V M S
1367 07 TRANSIENT                          V   S
1378 09 BOUNDARY                           V M S
1378 09 CALCULATION                    N   V   S
1378 09 CONSTANT                           V M S
1378 08 ENTHALPY                       N   V M
1378 07 FACTOR                         N   V   S
1378 09 FLAT                               V M S
1378 09 FLOW                           N   V M S
1378 10 FRICTION                       N   V M
1378 09 HEAT                             T V M S
1378 09 HIGH                             T V   S
1378 09 LAMINAR                            V M S
1378 09 LAYER                              V M S
1378 09 NUMERICAL                          V M S
1378 09 PLATE                          N   V   S
1378 08 RECOVERY                           V   S
1378 10 SKIN                                 M S
1378 07 SPECIFIC                           V   S
1378 09 SUPERSONIC                         V   S
1378 09 TEMPERATURE                    N     M
1378 09 TRANSFER                       N T V   S
1378 09 TURBULENT                          V   S
1378 07 VARIATION                      N   V M S
1378 09 WALL                               V M S
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1383 09 BOUNDARY          T V M S
1383 09 COEFFICIENT     N   V
1383 09 COMPRESSIBLE      T
1383 09 DISTRIBUTION    N   V   S
1383 10 DRAG                V M S
1383 09 FLOW            N T V   S
1383 09 GRADIENT        N   V M S
1383 09 HEAT              T V M S
1383 09 LAYER           N T V M
1383 09 PLANE           N T V M
1383 09 PRESSURE            V
1383 09 SEMIINFINITE        V   S
1383 09 SOLUTION        N   V M S
1383 09 TEMPERATURE         V M
1383 09 TRANSFER        N T V M S
1383 09 VANISHING           V
1383 09 VELOCITY            V   S
1383 09 VISCOUS             V M S
1399 10 COMPOSITE         T V M S
1399 09 CONDUCTION      N     M
1399 10 HEAT                V   S
1399 10 SLAB              T     S
1399 09 THEORY          N     M S
1399 09 TRANSIENT             M
1399 10 WALL            N   V   S
1406 08 AERODYNAMIC         V M S
1406 07 AMBIENT             V   S
1406 09 BEHAVIOUR       N T V   S
1406 09 BOUNDARY          T V   S
1406 07 COMPRESSIBLE        V   S
1406 05 CONDITION       N   V   S
1406 08 DISPLACEMENT        V   S
1406 08 DISSOCIATION    N   V   S
1406 08 DRAG            N   V   S
1406 06 EMISSIVITY      N   V M S
1406 08 ENTHALPY        N   V M S
1406 07 EQUILIBRIUM         V
1406 09 FLAT                V M
1406 09 FLOW            N   V   S
1406 10 FRICTION        N   V M S
1406 09 GRADIENT        N   V M S
1406 09 HEAT                V   S
1406 08 HEATING         N   V M S
1406 05 HIGH                V   S
1406 07 HYPERSONIC          V M
1406 07 INTERMEDIATE        V M S
1406 09 LAMINAR             V M S
1406 09 LAYER           N T V M
1406 09 MAXIMUM             V M S
1406 07 MEAN                  M S
1406 09 PLATE           N   V M S
1406 09 PRESSURE            V   S
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1406 06 RADIATIVE                           V   S
1406 09 SELFINDUCED                         V M S
1406 10 SKIN                                V M S
1406 09 SUPERSONIC                        T V M S
1406 05 SURFACE                             V M S
1406 09 TEMPERATURE                     N   V M S
1406 09 THICKNESS                       N   V M S
1406 09 TRANSFER                        N       S
1406 09 TURBULENT                           V M S
1406 09 ZERO                                V M S
1409 10 AEROFOIL                        N   V M
1409 10 BASE                              T V M S
1409 10 BLEED                                 M S
1409 10 BLUNT                               V
1409 09 CALCULATION                     N       S
1409 08 COMPRESSIBLE                          M
1409 07 CONSTANT                            V M
1409 10 EDGE                                  M S
1409 09 ENGINE                          N   V   S
1409 09 EXTERNAL                          T     S
1409 09 FLOW                            N     M S
1409 10 INTERACTION                       T V M
1409 10 INTERFERENCE                            S
1409 08 ISOENERGETIC                          M S
1409 10 JET                               T     S
1409 08 MIXING                          N   V
1409 10 PRESSURE                        N T V M S
1409 08 ROCKET                          N   V M
1409 10 SLIPSTREAM                          V M S
1409 09 SONIC                             T V M S
1409    STREAM                          N T   M S
1409 09 SUPERSONIC                        T   M S
1409 10 TRAILING                              M S
1409 08 TURBULENT                           V   S
1409 10 TWODIMENSIONAL                        M
1409 10 WAKE                            N   V   S
1415 08 BOUNDARY                            V   S
1415 08 BUFFETING                       N   V M S
1415 08 CAMBER                              V   S
1415 10 AERODYNAMIC                       T V   S
1415 08 CHORDWISE                               S
1415 06 CIRCULATION                         V M S
1415 07 COEFFICIENT                     N   V   S
1415 06 CONTROL                         N   V   S
1415 10 CRUISING                            V M
1415 10 DESIGN                          N T   M S
1415 08 DISTRIBUTION                    N   V   S
1415 08 DRAG                            N   V M S
1415 08 EDGE                            N   V   S
1415 09 FINITE                              V   S
1415 06 FLAP                            N   V   S
1415 07 FLOW                            N   V M S
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1415 08 FURM                    V M S
1415 08 GROWTH              N   V M S
1415 08 INDUCED                 V   S
1415 06 JET                     V M S
1415 06 LAMINARIZATION      N   V M
1415 08 LAYER                   V M
1415 08 LIFTING                 V M
1415 08 LOADING             N   V   S
1415 08 ONSET               N   V M S
1415 08 PEAKY                   V M S
1415 09 PERFORMANCE         N   V M S
1415 07 PREDICTION          N   V M S
1415 08 PRESSURE                V   S
1415 07 REQUIREMENT         N   V M S
1415 08 RISE                N   V   S
1415 08 ROOFTOP                 V M S
1415 10 SECTION             N T V   S
1415    SEPARATION          N   V M S
1415 10 SHAPE               N T V M S
1415 08 SHOCK                     M S
1415 08 SPOILER             N   V M S
1415 07 STRUCTURAL              V   S
1415 08 SUPERSONIC              V
1415 08 SURFACE                     S
1415 09 SWEPT                 T V M S
1415 08 THICK                   V M S
1415 08 THICKNESS                 M S
1415 06 THWAITES                V M S
1415 08 TRAILING                    S
1415 08 TRANSONIC               V   S
1415 07 UPPER                   V   S
1415 08 VELOCITY                V M
1415 08 WAVE                    V M S
1415 10 WING                N T V   S
1416 07 AEROFOIL                V   S
1416 08 AIR                     V M S
1416 09 AIRCRAFT            N   V M S
1416 06 BIPLANE                 V   S
1416 06 BLADE                   V   S
1416 08 BLOWING             N   V M S
1416 09 BOUNDARY            N T V M S
1416 08 BUFFETING           N T V M S
1416 06 BUMP                    V M S
1416 07 COMPLETE                V M S
1416 09 CONTROL             N T V M S
1416 06 CORNER              N   V M S
1416 08 COROTATING                M S
1416 08 COUNTERROTATING         V M S
1416 10 DELAY               N   V M S
1416 06 DESIGN              N   V M S
1416    DISTRIBUTED             V   S
1416 08 DIVERGENCE          N   V   S
1416 08 DRAG                    V   S
1416 08 EDGE                    V M S
1416 07 EXPERIMENT          N   V   S
1416 08 GENERATORS          N   V M S
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1416 08 HALF                V   S
1416 10 HIGH                V M S
1416 10 INDUCED           T V
1416 08 JET                 V   S
1416 09 LAYER             T   M S
1416 06 MULTIPLE            V M S
1416 08 ONSET               V   S
1416 06 PATH            N   V M S
1416 07 PHOTOGRAPH      N   V   S
1416 08 POSITION        N     M
1416 08 PRESSURE            V M S
1416 06 RAMP                V M S
1416 08 RISE            N   V M S
1416 06 ROW             N   V   S
1416 06 SCALE           N   V M S
1416 07 SCHLIEREN           V M S
1416 09 SEPARATION      N T V M
1416 10 SHOCK             T V   S
1416 08 SLOT                V M S
1416 09 SPEED                   S
1416 06 STRENGTH        N   V   S
1416 06 STRIP               V M S
1416 05 SUCTION         N   V M S
1416 06 SWEPTBACK           V M
1416 08 TECHNIQUE       N   V M S
1416 08 TRAILING            V M
1416 07 TUNNEL              V   S
1416 06 TWISTED             V   S
1416 06 TYPE                V   S
1416 08 VANE                V   S
1416 08 VELOCITY            V M
1416 08 VORTEX          N   V M S
1416 06 WEDGE               V
1416 07 WIND                V   S
1416 06 WING            N   V   S
1420 09 ANGLE           N   V M S
1420 09 ASPECT              V M
1420 09 ATTACK          N   V M S
1420 08 CONICAL             V
1420 10 DELTA             T V M S
1420 08 DISTRIBUTION    N       S
1420 08 DRAG                V   S
1420 08 EDGE              T V M S
1420 10 EDGED           N   V M S
1420 09 EXPERIMENT      N     M S
1420 09 FIELD           N T V M S
1420 09 FLOW            N T V   S
1420 09 HIGH                V M S
1420 08 LEADING           T V   S
1420 08 LOCATION        N   V M S
1420 09 NARROW              V M S
1420 08 PATH                V M S
1420 07 POSITION        N   V M
1420 08 PRESSURE            V M
1420 09 RATIO           N   V M S
1420 08 REYNOLDS        N   V   S
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1420 08 RISE                     N   V   S
1420 08 ROOT                         V   S
1420    SECTION                  N   V M S
1420 08 SEPARATION               N   V M S
1420 10 SHARP                      T V M S
1420 08 SHEET                        V
1420 08 STALLED                      V M S
1420 09 SURFACE                  N       S
1420 08 SWEEP                        V   S
1420 10 SWEPT                      T V
1420 08 TRANSONIC                        S
1420 09 TUNNEL                       V M
1420 10 TURBULENT                    V   S
1420 09 UPPER                            S
1420 08 VELOCITY
1420 08 VORTEX                       V M S
1420 08 VORTICITY                N   V   S
1420 09 WIND                         V M S
1420 10 WING                     N T V M S
1436 10 ATMOSPHERE               N T V   S
1436 09 BOUNDARY                       M
1436 08 CONVECTIVE                   V   S
1436 10 ENTHALPY                 N   V   S
1436 07 FLIGHT                       V M S
1436 09 HEAT                       T V M S
1436 10 IONIZED                        M S
1436 09 LAYER                    N   V M
1436 10 PLANETARY                  T V M S
1436 09 POINT                          M S
1436 07 PRESSURE                 N   V M
1436 08 RADIATION                      M S
1436 09 SPEED                    N T V   S
1436 10 STAGNATION                     M S
1436 10 SUPERSATELLITE               V
1436 08 TEMPERATURE              N       S
1436 09 THEORY                   N   V
1436 09 TOTAL                        V   S
1436 09 TRANSFER                 N T V   S
1436 10 VEHICLE                  N   V M S
1436 07 VELOCITY                 N       S
1436 08 WALL                         V M S
1437 07 AIR                      N T V M S
1437 09 ANALYSIS                 N   V
1437 06 BOUNDARY                       M S
1437 06 CHARGED                      V M S
1437 09 CONVECTIVE                   V   S
1437 09 DATA                     N     M S
1437 06 DIFFUSION                N   V M S
1437 07 DISSOCIATED                T V M S
1437 09 ESCAPE                       V M S
1437 09 EXPERIMENTAL                   M
1437 10 FLOW                           M
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1437 06 GAS                              V
1437 10 HEAT                           T V
1437 10 HYPERSONIC                       V   S
1437 10 HYPERVELOCITY                N T V M S
1437 10 IONIZATION                       V M S
1437 06 LAMINAR                              S
1437 06 LAYER                        N   V   S
1437 09 MACH                         N   V M S
1437 06 MIXTURE                      N   V   S
1437 06 PARTICLE                     N   V M SA
1437 10 POINT                          T V   S
1437 09 REENTRY
1437 09 SHOCK                            V M S
1437 10 STAGNATION                     T   M S
1437 09 THEORETICAL                      V M S
1437 10 TRANSFER                     N T V   S
1437 09 TUBE                         N     M
1437 09 VELOCITY                     N   V   S
1443 07 ANGLE                            V M S
1443 07 ATTACK                       N   V   S
1443 05 CHORD                            V M S
1443 05 CIRCULATION                  N   V M S
1443 05 COEFFICIENT                  N   V   S
1443 09 DENSITY                          V   S
1443 09 DISTRIBUTION                 N T V   S
1443 07 FLOW                             V M S
1443 05 FORCE                            V M S
1443 08 LIFT                         N   V M S
1443 06 MANOMETER                    N   V M S
1443 09 MEASUREMENT                  N   V M S
1443 09 MODEL                        N   V M S
1443 05 MOMENT                           V   S
1443 06 MULTIPLE                         V M S
1443 05 NORMAL                           V M S
1443 06 PHOTORECORDING                   V M S
1443 06 PITCHING                         V M S
1443 08 POTENTIAL                        V   S
1443 09 RECTANGULAR                      V   S
1443 05 REDUCTION                        V M S
1443 07 THEORY                       N   V
1443 06 TUBE                             V M S
1443 09 TUNNEL                       N   V   S
1443 09 VARIABLE                         V   S
1443 09 WIND                             V M S
1451 06 ASYMPTOTIC                       V   S
1451 10 AUTOMATIC                      T V M S
1451 06 AUTOPILOT                        V   S
1451 06 BANGBANG                         V   S
1451 06 COEFFICIENT                  N   V M S
1451 06 CONSTANT                           M S
1451 10 CONTROL                      N T V
1451 06 CRITERION                        V   S
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1451 06 CYCLES                                  N   V   S
1451 09 DIFFERENTIAL                                V   S
1451 06 DISTURBANCE                             N   V M  A
1451 09 EQUATION                                N     M S
1451 05 ESTIMATION                              N       S
1451 06 FEEDBACK                                N   V   S
1451 06 LIMIT                                       V   S
1451 06 LINEAR                                      V   S
1451 08 LINEARIZATION                           N   V M S
1451 10 LYAPUNOV                                  T V M SA
1451 07 MECHANICS                               N   V M S
1451 04 MISSILE                                     V M S
1451 06 MOTION                                  N   V M S
1451 10 NONLINEAR                                   V   S
1451 06 OSCILLATORY                                 V M S
1451 06 PERIODIC                                      M S
1451 06 PHASE                                       V   S
1451 06 PITCH                                       V M S
1451 04 PROBE                                   N   V   S
1451 06 RANDOM                                      V M S
1451 06 ROLL                                    N   V M S
1451 06 ROUTTHURWITZ                                V M S
1451 06 SOLUTION                                N   V M S
1451 06 SPACE                                   N     M S
1451 10 STABILITY                               N   V M S
1451 06 STABLE                                      V M S
1451 06 STATE                                       V M S
1451 09 THEORY                                  N T V   S
1451 06 TIMEOPTIMUM                                 V M
1451 06 TRAJECTORIES                            N   V   S
1451 06 TRANSIENT                                   V M S
1451 06 YAW                                         V
1467 08 ACCELERATING                                V   S
1467 09 AEROFOIL                                N T V
1467 09 APPROXIMATE                               T V M S
1467 07 CALCULATION                             N   V M
1467 08 DECELERATING                                V M S
1467 08 DISTRIBUTION                            N   V   S
1467 09 DISTURBANCE                                 V M
1467 08 DRAG                                    N   V
1467 09 EQUATION                                N T V   S
1467 09 FLOW                                    N T V M
1467 07 MACH                                    N   V
1467 10 NONLIFTING                                  V   S
1467 09 NONLINEAR                                   V M
1467 07 PRESCRIBED                                  V M S
1467 09 PRESSURE                                    V   S
1467 08 SHAPE                                   N   V M S
1467 09 SMALL                                       V M S
1467 09 SOLUTION                                N T   M S
1467 09 THEORY                                  N T V M S
1467 09 TRANSONIC                                 T V   S
1467 09 TWODIMENSIONAL                              V   S
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1476	10	BLASIUS		T	V	M	S
1476	10	BOUNDARY		T			S
1476		CONDITION	N	T			
1476	09	EQUATION	N	T	V	M	
1476	10	FLOW	N				S
1476	10	INTERACTION	N			M	S
1476	10	ISOBARIC			V	M	S
1476	10	MIXING			V	M	
1476	10	PARALLEL				M	S
1476	09	POINT		T			
1476	09	SOLUTION	N		V	M	
1476	10	STREAMS	N				
1476	09	THREE		T			S
1509	09	APPROXIMATION	N	T			
1509	10	ATMOSPHERE	N			M	
1509	09	DISTRIBUTION	N			M	S
1509	10	EARTH			V	M	S
1509	10	EVAPORATION	N			M	S
1509	10	FREENTERING			V	M	
1509	09	GRAPHICAL		T	V	M	S
1509	09	GROSS		T		M	
1509	09	HEAT		T	V	M	
1509	09	LARGE		T		M	S
1509	09	NET		T	V	M	S
1509	10	POINT	N				
1509	10	PROTECTION				M	S
1509	10	QUARTZ			V	M	S
1509	09	RATE	N	T			
1509	10	SHIELD	N			M	
1509	09	SMALL		T	V		
1509	10	SPACE			V		
1509	10	STAGNATION			V		S
1509	10	SUBLIMATION		T	V	M	S
1509	09	SURFACE		T	V	M	
1509	09	TEMPERATURE		T			S
1509	09	TRANSFER		T	V		
1509	10	VEHICLE	N			M	S
1569	07	AVERAGE					S
1569	09	BOUNDARY		T		M	S
1569	07	COEFFICIENT	N			M	
1569	07	DEFICICIENCY			V		S
1569	06	DRAG	N		V		S
1569	10	EDGE	N	T	V		S
1569	08	EXPANSION			V	M	S
1569	10	FLAT			V	M	
1569	09	FLOW			V	M	S
1569	08	FRICTION			V	M	S
1569	08	GROWTH	N		V	M	S
1569	09	HYPERSONIC				M	S
1569	07	IMPACT			V	M	S
1569	09	INDUCED					S

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1569 10 INTERACTION              N T V M S
1569 10 INVISCID                     V
1569 09 LAYER                      T V M S
1569 10 LEADING                    T V M S
1569 07 LOCATION                 N       S
1569 10 MACH                     N T   M
1569 09 MEASUREMENT              N   V M S
1569 07 MOMENTUM                     V
1569 07 NUMBER                         M S
1569 10 PLATE                    N
1569 09 PRESSURE                 N   V   S
1569 07 PROFILE                  N   V M S
1569 08 REFLECTED                        SA
1569 10 SHARP                        V
1569 10 SHOCK                      T V M S
1569 08 SKIN                         V M
1569 07 STRENGTH                 N   V M S
1569 07 SURVEY                   N     M S
1569 05 TOTAL                        V M S
1569 09 TUNNEL                       V M S
1569 10 VISCID                       V M S
1569 10 WAVE                     N T V   S
1569 09 WIND                         V   S
1572 06 AFTERBODY                        S
1572 09 ANGLE                          M S
1572 07 ATTACK                   N   V   S
1572 09 BLUNT                        V M S
1572 06 BLUNTED                      V M
1572 10 BLUNTNESS                N T V   S
1572 10 BODY                     N   V M S
1572 09 BOUNDARY                   T V M S
1572 09 COMBINED                       M S
1572 08 CONTINUUM                    V M
1572 06 DECAY                    N       S
1572 08 DETACHED                     V M S
1572 10 DISPLACEMENT             N T V
1572 09 DISTRIBUTION             N   V   S
1572 09 DISTURBANCE                    M S
1572 07 DOWNSTREAM                   V   S
1572 10 EDGE                     N T   M
1572 09 EFFECT                   N T V M S
1572 08 ENTROPY                      V M S
1572 10 FLAT                         V M
1572 09 FLOW                     N T   M S
1572 09 HEAT                         V M S
1572 09 HIGH                       T   M S
1572 09 HYPERSONIC                 T V M
1572 07 INCIDENCE                N   V   S
1572 07 INFLUENCE                    V M S
1572 07 INNER                        V M S
1572 10 INTERACTION                      S
1572 10 INVISCID                     V   S
1572 09 LAMINAR                        M S
1572 09 LAYER                    N T V M S
1572 10 LEADING                    T V M S
1572 07 LOCAL                        V M S
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1572 10 MACH                            N   V   S
1572 09 MEASUREMENT                     N   V M S
1572 07 MODEL                           N       S
1572 07 ORDER                               V M S
1572 06 OSCILLATORY                         V   S
1572 07 OUTER                               V M
1572 10 PLATE                           N   V M S
1572 07 PRESSURE                        N   V M S
1572 09 RATE                            N   V M S
1572 10 SHAPE                           N   V M
1572 09 SHARP                               V M
1572 10 SHOCK                                 M S
1572 07 SIMILARITY                          V M S
1572    SIMILITUDE                      N   V   S
1572 09 SMALL                                 M S
1572 07 SOLUTION                        N   V   S
1572 07 STUDY                           N   V   S
1572 09 SURFACE                               M S
1572 09 TEMPERATURE                       T   M S
1572 07 THEORETICAL                         V M
1572 09 THEORY                          N   V   S
1572 10 THIN                                V M S
1572 10 TIP                                   M S
1572 09 TRANSFER                            V M S
1572 09 TUNNEL                              V   S
1572 10 VISCID                              V   S
1572 10 VISCOUS                             V
1572 10 WAVE                                V   S
1572 06 WEDGE                           N       S
1572 09 WIND                                V   S
1572 07 ZERO                                V M S
1574 09 ALTITUDE                                S
1574 10 BLUNT                                 M
1574 10 BODY                            N     M S
1574 09 CALCULATION                     N     M S
1574 10 CHEMICALLY                            M S
1574    CONDITION                       N   V M S
1574 07 DENSITY                             V M S
1574 08 DIATOMIC                            V   S
1574 10 DISSOCIATION                    N T V M S
1574 00 DISTRIBUTION                    N T V M S
1574 06 EQUILIBRIUM                         V M S
1574 08 EXPANSION                           V   S
1574 09 FIELD                           N       S
1574 09 FLIGHT                          N T V   S
1574 09 FLOW                            N T   M S
1574 08 FROZEN                              V M S
1574 10 GAS                             N   V   S
1574 09 HIGH
1574 09 HYPERSONIC                        T V M
1574 07 INITIAL                             V M
1574 10 INVISCID                          T   M
1574 08 MEYER                               V   SA
1574 08 MIXTURE                         N   V M
1574 08 MODEL                               V M S
1574 10 MOLECULAR                         T V
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1574 08 NITROGEN                              V
1574 10 NONEQUILIBRIUM                      T V M S
1574 07 ONEDIMENSION                          V M S
1574 08 OXYGEN                                V   S
1574 08 PRANDTL                               V M S
1574 09 PRESSURE                            T V M S
1574 10 REACTING                              V M S
1574 07 REGION                            N   V M
1574 08 STAGNATION                                S
1574 10 STREAMLINE                        N   V M S
1574 07 SUPERSONIC                            V M S
1574 07 TEMPERATURE                           V M S
1574 07 VELOCITY                              V M S
1575 06 ADIABATIC                             V   S
1575 06 ANGLE                             N   V   S
1575 10 ATOMIC                              T V   S
1575 06 BEHIND                                  M S
1575 06 BLUNT                                 V M S
1575 06 BODY                              N   V   S
1575 05 CALCULATION                       N   V   S
1575 08 CHEMICAL                                  S
1575 07 CONDITION                         N   V   S
1575 09 CONICAL                                 M S
1575 06 CONVERGENT                            V M S
1575 06 DENSITY                           N   V
1575 08 DEVIATION                             V   S
1575 10 DISSOCIATING                          V   S
1575 10 DISSOCIATION                      N   V   S
1575 05 DISTANCE                          N       S
1575 06 DIVERGENT                                 S
1575 06 DRAG                              N   V M S
1575 09 EQUATION                          N   V M S
1575 08 EQUILIBRIUM                       N   V M S
1575 09 FINITE                                V   S
1575 09 FLOW                              N   V M
1575 05 FRACTION                          N   V   S
1575 10 FREEZING                              V   S
1575 06 FRICTIONLESS                          V M S
1575 10 GAS                               N   V M S
1575 05 HEAT                                  V   S
1575 09 HYPERSONIC                          T V M S
1575 10 IDEAL                                 V M S
1575 06 MACH                                  V   S
1575 10 MOLECULAR                             V M S
1575 09 NEARLY                                V M S
1575 06 NITROGEN                          N   V M S
1575 10 NOZZLE                            N T V M S
1575 06 ONEDIMENSIONAL                        V   S
1575 06 OPTIMUM                                 M S
1575 06 OXYGEN                            N   V M S
1575 10 PHENOMENA                         N   V M S
1575 05 PRESSURE                          N     M S
1575 06 QUASI                                 V   S
1575 06 RATE                              N     M
1575 06 REACTION                          N   V M
1575 10 RECOMBINATION                     N T V M SA
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1575 10 RELAXATION                          V M S
1575 06 ROCKET                              V   S
1575 06 SECTION                         N   V M S
1575 06 SHAPE                           N   V M S
1575 06 SHOCK                               V M S
1575 09 SOLUTION                        N   V   S
1575 06 SPHERE                          N   V M S
1575 08 STAGNATION                          V   S
1575 06 STANDOFF                              M S
1575 05 TEMPERATURE                     N   V M
1575 05 TEST                                V   S
1575 05 TRANSFER                            V
1575 06 TUBE                            N   V   S
1575 09 TUNNEL                            T V   S
1575 05 VISCOSITY                       N   V   S
1575 06 WAVE                            N     M S
1575 09 WIND                              T     S
1575 06 WORKING                             V M S
1576 07 AHEAD                                   S
1576 08 AIR                                 V M S
1576 08 AMBIENT                             V   S
1576 09 ANALYSIS                        N   V M S
1576 08 APPROCACHING                        V M S
1576 06 ATOM                                V M S
1576 08 ATOMIC                              V   S
1576 08 BLOW                                V M S
1576 10 BLUNT                               V M
1576 10 BODY                            N   V
1576 08 BOUNDARY                            V M S
1576 08 BOW                                 V   S
1576 08 CHEMICALLY                          V   S
1576 08 DENSITY                             V M S
1576 08 DETACHMENT                          V M
1576 10 DISSOCIATED                       T V M S
1576 08 DISSOCIATION                    N   V   S
1576 08 DISTANCE                        N   V   S
1576 06 ENERGY                          N   V   S
1576 08 EQUILIBRIUM                         V M
1576 09 FLOW                            N T V M S
1576 06 FRACTION                        N   V M S
1576 09 FREE                              T V M S
1576 08 FROZEN                              V   S
1576 05 FUNCTION                            V M S
1576 08 GAS                             N   V M S
1576 07 GEOMETRY                        N   V M S
1576 08 HEAT                                V
1576 09 HIGH                                V   S
1576 10 HYPERSONIC                            M
1576 07 INITIALLY                           V M S
1576 08 INVISCID                          T V M S
1576 08 IONIZATION                      N   V   S
1576 08 LAYER                               V M S
1576 06 MASS                                V M S
1576 08 NITROGEN                            V M
1576 08 NONCATALYTIC                        V M S
1576 10 NONEQUILIBRIUM                      V M S
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1576 10 NOSED                    V M S
1576 09 NUMBER                   V M S
1576 08 OXYGEN                   V M S
1576 07 PROPERTY                 V   S
1576 07 RATIO                N   V   S
1576 09 REYNOLDS                 V   S
1576 08 SHOCK                N   V   S
1576 10 STAGNATION             T   M S
1576 08 STANDOFF                 V   S
1576 07 STATE                N     M S
1576 09 STREAM               N T   M S
1576 08 SURFACE              N   V M S
1576 08 TEMPERATURE          N   V   S
1576 08 THICKNESS            N     M S
1576 07 TRANSFER             N   V M S
1576 08 UNDISSOCIATED              M S
1576 08 VIBRATIONALLY        N   V M S
1576 09 VISCOUS                T V M S
1578 08 AIR                        M S
1578 10 ALTITUDE                 V M S
1578 10 BLUNT                  T   M S
1578 10 BODY                 N   V M S
1578 01 CHEMICAL                 V
1578 07 CORRELATED               V M S
1578 10 DISSOCIATING             V M
1578 10 DISSOCIATION           T   M S
1578 07 DISTANCE             N     M S
1578 07 DISTRIBUTION         N   V M S
1578 09 FLIGHT               N       S
1578 09 FLOW                 N T     S
1578 10 GAS                  N   V   S
1578 09 HIGH                       M S
1578 09 HYPERSONIC                 M S
1578 10 IDEAL                    V M S
1578 10 INVISCID
1578 10 LAW                  N   V M S
1578 10 MODEL                    V   S
1578 10 NONEQUILIBRIUM         T   M
1578 10 NOSED                  T V M
1578 10 RECOMBINATION        N     M S
1578 10 SCALING              N T   M S
1578 08 SHOCK                      M S
1578 08 STANDOFF                 V
1578 07 TEMPERATURE                  S
1578 10 VISCOUS                      S
1588 06 ABRUPT                   V M
1588 06 ADJUSTABLE               V M
1588 06 AIR                      V   S
1588 09 ANALYSIS             N   V   S
1588 10 AXIAL                  T V M S
1588 06 BAFFLES              N     M S
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1588 10 BLADE                             T V
1588 06 BLADING                         N   V   S
1588 06 BLEED                           N   V M S
1588 09 CHARACTERISTIC                  N   V M S
1588 06 CIRCUMFERENTIAL                       M S
1588 06 COEFFICIENT                     N   V   S
1588 08 COMPLETE                            V   S
1588 10 COMPRESSOR                      N T V M S
1588 09 DISCONTINUITY                           S
1588 08 DISTRIBUTION                            S
1588 05 EFFECT                          N   V M S
1588 09 EFFICIENCY                      N       S
1588 08 FIRST                               V   S
1588 10 FLOW                            N T V M S
1588 08 FRONT                               V   S
1588 06 GUIDE                                   S
1588 10 HIGH                                V M S
1588 06 HYSTERESIS                              S
1588 08 INLET                                   S
1588 08 INTERACTION                     N   V M S
1588 08 INTERMEDIATE                          M S
1588 08 LIMIT                               V M S
1588 08 LINE                            N   V M S
1588 08 LOW                                 V   S
1588 08 MATCHING                        N   V M S
1588 10 MULTISTAGE                          V M S
1588 09 OPERATION                       N T     S
1588 10 PART                                V M S
1588 09 PERFORMANCE                     N       S
1588 10 PRESSURE                            V   S
1588 06 PROGRESSIVE                         V M S
1588 06 RADIAL                              V M S
1588 10 RATIO                               V M S
1588 10 RAW                             N   V M S
1588 06 ROTATING                            V M
1588 08 SINGLE                              V   S
1588 10 SPEED                           N   V   S
1588 08 STACKING                                S
1588 08 STAGE                           N   V M S
1588 10 STALL                           N   V
1588 08 STALLED                         N   V M S
1588 10 STALLING                        N   V M S
1588 08 SURGE                           N       S
1588 06 TRANSITION                      N   V   S
1588 07 TYPE                                V M S
1588 08 UNSTALLED                       N   V M S
1588 06 UNSTEADY                            V M S
1588 06 VANE                            N   V   S
1589 07 ANALYSIS                        N       S
1589 10 ANEMOMETER                      N   V M
1589 10 AXIAL                             T V   S
1589 08 BLADE                                 M S
1589 07 CHARACTERISTIC                  N   V M S
1589 10 COMPRESSOR                      N T   M
1589 08 DISCONTINUITY                   N   V M S
1589 07 EQUIVALENT                            M S
1589 07 FAILURE                         N       S
1589 09 FLOW                              T V   S
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1589 09 HOT                                 V
1589 09 INVESTIGATION                   N   V   S
1589 10 MULTISTAGE                            M S
1589 07 PERFORMANCE                     N   V
1589 07 PRESSURE                            V M S
1589 07 PROGRESSIVE                         V M S
1589 07 RATIO                               V M S
1589 08 RESONANT                            V M S
1589 08 ROOT                                V M S
1589 10 ROTATING                              M
1589 09 SINGLE                              V   S
1589 08 STACKING                            V   S
1589 10 STAGE                               V M S
1589 10 STALL                           N T V M S
1589 10 SURGE                           N T     S
1589 08 TIP                                 V M S
1589 08 VIBRATION                       N   V   S
1589 08 WEIGHT                              V M S
1589 09 WIRE                                V M S
1590 09 ANALYSIS                        N   V   S
1590 06 ANGLE                           N   V   S
1590 06 ANNULUS                             V M S
1590 06 AREA                            N   V   S
1590 10 AXIAL                             T V   S
1590 06 BLADE                               V   S
1590 06 CASCADE                             V M S
1590 06 CHANGE                              V   S
1590 10 CHARACTERISTIC                  N T V   S
1590    CHOKING                             V   S
1590 06 COEFFICIENT                     N   V M S
1590 10 COMPRESSOR                      N T V   S
1590 06 CONSTANT                            V M S
1590 06 CURVE                           N   V M S
1590 05 DATA                            N   V M
1590 08 DESIGN                          N   V   S
1590 07 DISTRIBUTION                    N     M S
1590 06 DOUBLE                              V   S
1590 09 FLOW                            N T V M S
1590 06 GUIDE                               V M S
1590 06 HYSTERESIS                      N   V M S
1590 08 IDEALIZED                           V M S
1590 06 INLET                               V M S
1590 06 KNEE                            N   V   S
1590 06 LINE                            N   V   S
1590 06 LOADING                         N   V M
1590 06 LOSS                            N     M S
1590 07 MACH                                V M S
1590 08 MASS                                V   S
1590 10 MATCHING                        N T V M S
1590 07 NUMBER                          N   V   S
1590 06 ONE                             N   V   S
1590 08 OPERATION                       N     M S
1590 08 PERCENTAGE                            M
1590 10 PERFORMANCE                     N T V M
1590 06 PITCH                               V   S
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1590 08 POINT                           N       S
1590 07 PRESSURE                            V   S
1590 08 RANGE                               V   S
1590 05 RATIO                           N   V   S
1590 08 SLOPE                               V M S
1590 08 SPEED                           N   V M S
1590 10 STAGE                             T V M S
1590 06 STAGGER                         N   V M S
1590 08 STALLING                              M
1590 08 SURGE                           N   V
1590 06 TEMPERATURE                         V M S
1590 05 TEST                                V   S
1590 05 TOTAL                               V   S
1590 06 TWO                             N   V M
1590 06 UNSTALLING                          V M S
1590 06 UPRATING                            V   S
1590 06 VALUED                              V   S
1590 06 VANE                                V M S
1590 07 VELOCITY                            V   S
1591 09 APPROXIMATE                       T V   S
1591 10 CHOKE                             T V M S
1591 10 COMPRESSION                           M
1591 10 COMPRESSOR                      N T
1591 09 EQUATION                        N T   M S
1591 09 FLOW                            N       S
1591 10 ISENTROPIC                          V
1591 09 LINE                            N T   M S
1591 10 NOZZLE                          N     M
1591 10 SONIC                                   S
1591 10 THROAT                              V   S
1591 09 VELOCITY                        N   V M
1592 08 AIR                                 V   S
1592 07 ANGLE                           N   V M S
1592 10 AXIAL                             T V M S
1592 08 BENDING                             V M
1592 08 BLADE                           N   V   S
1592 08 BLADING                         N   V   S
1592 07 COEFFICIENT                     N   V   S
1592 10 COMPRESSOR                      N T   M S
1592 07 CONSTANT                            V   S
1592 05 CONSTRUCTION                    N     M S
1592 09 CURVE                           N   V M S
1592 09 DESIGN                          N T V M S
1592 06 DISK                                V M
1592 07 EFFICIENCY                      N   V M S
1592 07 FLOW                                V   S
1592 07 FORM                            N   V M S
1592 07 FREE                                V M S
1592 09 GENERALIZED                         V M S
1592 08 IMPULSE                             V M S
1592 06 JUMO                            N   V M S
1592 07 OUTLET                              V   S
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1592 08 REACTION                            V
1592 07 RISE                        N       V   M   S
1592 08 ROTOR                               V       S
1592 08 STAGE                               V       S
1592 08 STATOR                              V   M   S
1592 08 STRESS                      N       V       S
1592 07 TEMPERATURE                         V       S
1592 08 VORTEX                              V       S
1594 09 AERODYNAMIC                         V       S
1594 06 AMPLITUDE                           V   M   S
1594 07 CIRCUIT                     N       V   M
1594 07 COUPLED                             V   M   S
1594 08 DAMPING                             V   M   S
1594 08 DAMPOMETER                  N               S
1594 08 DECAYING                            V       S
1594 09 DEGREE                              V
1594 10 DERIVATIVE                  N   T   V   M   S
1594 09 DIRECT                              V   M   S
1594 10 DISPLACEMENT                N       V       S
1594 08 DRIVE                       N       V   M   S
1594 08 ELASTIC                             V   M   S
1594 08 ELECTRICAL                                  S
1594 08 ELECTRICALLY                        V   M   S
1594 08 EXCITATION                  N       V       S
1594 08 EXCITED                             V   M   S
1594 07 EXTERNAL                            V       S
1594 08 FLUTTER                             V
1594 06 FORCE                               V   M   S
1594 08 FORCING                             V   M   S
1594 07 FREE                                V   M   S
1594 10 FREEDOM                     N           M   S
1594 06 FREQUENCY                           V   M   S
1594 08 INDIRECT                            V   M   S
1594 08 INEXORABLE                          V   M   S
1594 07 INTEGRATION                         V   M   S
1594 07 INTERNAL                            V       S
1594 08 LOGARITHMIC                         V   M   S
1594 09 MEASUREMENT                 N   T   V   M   S
1594 07 METHOD                      N       V       S
1594 10 OSCILLATION                 N               S
1594 08 OSCILLATORY                     T   V       S
1594 08 PHASE                               V   M   S
1594 06 PICKUP                      N           M   S
1594 09 PITCH                               V   M   S
1594 07 PLOTTING                    N       V   M   S
1594 07 PRESSURE                            V   M   S
1594 07 REACTION                    N       V   M
1594 08 RESONANCE                   N       V
1594 09 RIGID                               V   M   S
1594 07 SELF                                V   M   S
1594 10 SINUSOIDAL                          V   M   S
1594 08 STIFFNESS                           V   M   S
1594 09 TRANSLATION                 N       V       S
1594 09 TUNNEL                          T   V       S
1594 09 VERTICAL                            V       S
1594 06 WALL                        N       V   M   S
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1594 09 WIND                     T V M S
1594 09 WING                   N   V M S
1596 09 ANALYSIS               N     M
1596 09 APPLIED
1596 08 BENDING                N   V   S
1596 08 CENTRE                       M S
1596 08 COMPRESSION            N   V M S
1596 10 CROSSED                  T     S
1596 10 CROSSING                       S
1596 06 DESIGN                 N   V   S
1596 09 DETERMINATION          N   V M
1596 08 DISPLACED                  V   S
1596 10 FLEXURE                  T V   S
1596 09 FORCE                      V
1596 09 LOAD                   N   V   S
1596 05 MAXIMUM                    V
1596 07 NONLINEAR                      S
1596 10 PIVOT                  N T V M S
1596 10 POINT                  N   V M S
1596 09 PROPERTY               N   V M
1596 07 RELATION               N T     S
1596 08 ROTATION               N T V   S
1596 10 ROTATIONAL                 V   S
1596 10 STIFFNESS              N   V M S
1596 06 STRESS                 N   V   S
1596 10 STRIP                  N       S
1596 08 TENSION                N   V M S
1596 08 TORQUE                 N T V M S
1597 06 AERODYNAMIC                V M
1597 09 AEROFOIL               N T V M S
1597 10 BLUNT                    T V   S
1597 10 BLUNTING               N   V M S
1597 08 CHORD                          S
1597 06 DAMPING                      M S
1597 10 DERIVATIVE             N T   M S
1597 06 EQUIPMENT              N   V M S
1597 09 FLOW                   N T V M S
1597 06 FREQUENCY                  V M
1597 08 GEAR                   N
1597 06 LESS                   N   V   S
1597 08 MACH                   N     M S
1597 09 MEASUREMENT            N T V M S
1597 08 MODEL                  N   V M S
1597 10 MOMENT                   T V   S
1597 10 NOSE                     T V
1597 10 NOSED                      V M S
1597 10 OSCILLATING            N T V   S
1597 06 PARAMETER                  V M S
1597 06 PERCENT                N   V   S
1597 06 PISTON                     V M
1597 10 PITCHING                 T V M S
1597 08 RATIO                      V M
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1597 08 SINGLE
1597 06 STIFFNESS                   M
1597 09 SUPERSONIC              T V   S
1597 08 SUPPORT                   V   S
1597 05 THEORY                N       S
1597 08 THICKNESS                 V   S
1597 07 TUNNEL                N   V M S
1597    TWODIMENSIONAL          T V M
1597 08 WEDGE                     V M
1597 07 WIND                      V
1598 09 AERODYNAMIC               V   S
1598 09 ARC                       V   S
1598 06 BLUNT                     V   S
1598 06 CONTROL                     M
1598 10 DAMPING               N   V M S
1598 09 DERIVATIVE            N       S
1598 09 DISCHARGE             N   V M S
1598 09 DYNAMIC                     M S
1598 10 EXHAUST                     M
1598 06 FLAP                  N   V   S
1598 07 FLOW                      V M S
1598 10 HYPERVELOCITY           T V M S
1598 10 JET                   N   V   S
1598 09 MEASUREMENT           N   V   S
1598 06 REENTRY                     M S
1598 10 ROCKET                    V   S
1598 08 SEPARATION            N     M S
1598 09 SIMULATION            N   V M S
1598 10 STABILITY             N   V M S
1598 09 STRUCTURAL                V   S
1598 09 TUNNEL                  T V M S
1598 10 VEHICLE               N   V   S
1598 09 WIND                    T   M
1605 10 BLUNTED                   V M S
1605 10 CONE                    T V M S
1605 10 CONFIGURATION         N T   M S
1605 10 CYLINDER                T
1605 10 FLARE                   T V M S
1605 09 FLOW                      V M
1605 09 HYPERSONIC
1605 09 IMPACT                    V
1605 09 INCIDENCE             N T     S
1605 10 MACH                  N T V   S
1605 09 MEASUREMENT           N T   M S
1605 10 NEWTONIAN                   M S
1605 10 NODE                  N   V M S
1605 10 PRESSURE              N T
1605 10 SLENDER                   V M
1605 09 SLIGHTLY                    M
1605 08 STATIC                      M
1605 10 SURFACE                   V M S
1605 09 THEORY                    V M S
1605 09 TUNNEL                      M S
1605 09 WIND                        M S
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1606	10	AERODYNAMIC		T			S
1606	07	ALTITUDE	N		V	M	
1606	07	ANALYTICAL			V		S
1606	09	APPROXIMATION	N	T	V	M	S
1606	10	BODY	N		V	M	S
1606	07	BOUNDARY			V	M	S
1606	07	EFFECT	N				
1606	10	ENTHALPY				M	S
1606	07	EQUILIBRIUM			V	M	
1606	09	ESTIMATE	N		V		S
1606	07	ESTIMATION	N		V		S
1606	10	FLIGHT	N	T	V	M	S
1606	07	FLOW	N		V		S
1606	07	FUSED			V	M	S
1606	07	HEAT			V	M	
1606	10	HEATING		T	V		S
1606	09	INTERMEDIATE			V		S
1606	07	LAMINAR			V	M	S
1606	07	LAYER	N		V		S
1606	07	LOCAL			V	M	S
1606	07	MACH			V	M	S
1606	07	MILD			V	M	S
1606	07	NUMBER	N		V		S
1606	08	RADIATION			V		S
1606	07	RATE	N	T	V	M	S
1606	07	REYNOLDS			V	M	S
1606	07	SILICA				M	S
1606	08	SKIN	N		V		S
1606	10	SLENDER			V		S
1606	07	STEEL				M	S
1606	07	STRUCTURE	N		V	M	S
1606	09	SUPERSONIC			V	M	S
1606	07	SURFACE			V	M	S
1606	07	TEMPERATURE	N			M	
1606	07	THICK			V		S
1606	07	THIN			V		S
1606	07	TIME			V	M	S
1606	08	TRANSITIONAL			V		S
1606		TURBULENT			V	M	S
1606	07	VARIATION	N		V	M	S
1606	10	WING	N			M	S
1608	10	AERODYNAMIC		T			S
1608	09	BOUNDARY				M	S
1608	09	FLOW	N		V		S
1608	10	FLUCTUATION				M	
1608	09	FREE			V	M	S
1608	09	HOT			V		
1608	09	LAYER	N			M	S
1608	09	MACH					S
1608	10	MASS			V	M	S

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1608 09 MEASUREMENT                       N       S
1608 10 NOISE                             N T V M S
1608 10 NOZZLE                            N     M S
1608 09 NUMBER                            N   V   S
1608 10 SOUND                                 V M
1608 09 STREAM                                  M
1608 09 SUPERSONIC                          T V M S
1608 10 TUNNEL                            N T V
1608 09 TURBULENT                             V M S
1608 10 WALL                              N       S
1608 10 WAVE                              N     M S
1608 10 WIND                                T V   S
1608 09 WIRE                                  V M S
1613 07 AERODYNAMIC
1613 10 AIR                                 T     S
1613 09 ANALYTICAL                            V   S
1613 10 ATMOSPHERE                        N T V   S
1613 10 CONTRACTION                       N T   M
1613 09 DISTANCE                          N     M S
1613 10 DRAG                              N T   M S
1613 10 ECCENTRICITY                      N   V M S
1613 10 ELLIPTIC                                  S
1613 07 FORCE                             N     M S
1613 09 METHOD                            N   V   S
1613 06 OBLATE                                  M S
1613 10 ORBIT                               T V M
1613 10 ORBITAL                               V
1613 10 PERIGEE                               V   S
1613 09 PERIOD                            N     M
1613 09 PERTURBATION                            M S
1613 08 ROTATION                          N   V
1613 10 SATELLITE                           T   M S
1613 09 SMALL                                 V M S
1613 10 SPHERICALLY                         T V M S
1613 09 STUDY                             N   V   S
1613 10 SYMMETRICAL                         T V M
1613 07 VECTOR                            N     M S
1613 07 VELOCITY                              V
1614 10 AIR                                 T     S
1614 09 ANALYTICAL                              M
1614 10 ATMOSPHERE                        N T
1614 08 CIRCULAR                              V M S
1614 10 CONTRACTION                       N T V   S
1614 08 DENSITY                           N       S
1614 07 DISTANCE                          N   V
1614 10 DRAG                              N T   M S
1614 10 ECCENTRICITY                      N     M
1614 10 ELLIPTIC                              V M S
1614 08 LIFE                                  V M
1614 10 OBLATE                              T     S
1614 10 ORBIT                               T V
1614 08 ORBITAL
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1614 08 PERIGEE                     S
1614 07 PERIOD             N      M S
1614 10 ROTATING               V  M S
1614 10 SATELLITE          N T V  M S
1614 09 SMALL                  V  M S
1614 09 SOLUTION           N   V  M S
1615 07 AERODYNAMIC               M
1615 10 AIR                  T    M S
1615 10 ATMOSPHERE         N      M S
1615 09 CONTRACTION        N T V  M S
1615 08 DENSITY                     S
1615 07 DISTANCE           N   V  M S
1615 10 DRAG               N T V    S
1615 10 ECCENTRICITY       N T V  M S
1615 10 ELLIPTIC               V  M
1615    FORCE              N      M
1615 08 GRAVITATIONAL          V  M S
1615 07 HEIGHT                 V  M S
1615 10 HIGH                 T V  M S
1615 08 LIFETIME           N   V    S
1615 08 LUNISOLAR              V  M S
1615 10 ORBIT                T V    S
1615 08 ORBITAL
1615 08 OSCILLATION        N   V
1615 08 PERIGEE            N   V    S
1615 07 PERIOD             N      M S
1615 07 PERTURBATION       N   V    S
1615 07 PRESSURE           N   V
1615 08 RADIATION              V  M S
1615 10 SATELLITE            T V    S
1615 08 SOLAR                       S
1615 10 SPHERICALLY                 S
1615 10 SYMMETRICAL            V
1615 07 TIME                      M S
1615 07 VARIATION          N   V  M S
1616 10 AIR                  T V
1616 10 ATMOSPHERE           T    M S
1616 10 ATMOSPHERIC               M
1616 10 AXIS               N        S
1616 07 CALCULATION        N   V  M
1616 09 CHANGE                      S
1616 10 DENSITY            N T V  M S
1616 09 DETERMINATION      N T
1616 09 DISTANCE           N   V    S
1616 10 DRAG               N        S
1616 10 ELLIPTIC                  M S
1616 09 EXPLORER           N
1616 10 HEIGHT             N T V  M S
1616 09 OBSERVATION        N T    M S
1616 10 ORBIT              N   V
1616 10 PERIGEE                V  M S
1616 07 PERIOD             N   V  M S
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1616 09 RATE                V
1616 10 RESISTANCE          V M S
1616 10 SATELLITE         T     S
1616 10 SCALE             T V   S
1616 09 SEMIMAJOR           V   S
1616 09 SPUTNIK         N     M S
1616 09 TIME            N
1616 09 UPPER             T V   S
1616 09 VANGUARD        N     M
1617 10 AIR               T V
1617 10 APOGEE              V   S
1617 10 ATMOSPHERE      N T
1617 10 AXIS                  M S
1617 09 CHANGE          N   V M S
1617 10 DENSITY           T V M S
1617 09 DETERMINATION   N T
1617 09 DISTANCE              M S
1617 10 DRAG            N   V M S
1617 10 EXPLORER        N       S
1617 09 HEIGHT          N     M
1617 09 MOTION              V M S
1617 10 OBSERVATION     N T     S
1617 10 ORBIT           N       S
1617 10 PERIGEE         N   V
1617 10 RELATIVE                S
1617 10 SATELLITE         T
1617 10 SCALE                 M S
1617 09 SEMIMAJOR             M
1617 10 SPUTNIK         N   V M S
1617 09 UPPER             T   M S
1617    VARIATION             M S
1618 10 APOGEE              V M S
1618 08 ARTIFICIAL        T V   S
1618 10 ATMOSPHERIC         V   S
1618 08 AXIS            N   V M S
1618 09 BELT            N       S
1618 10 DECAY           N T     S
1618 10 DRAG            N   V M S
1618 09 EARTH               V   S
1618 08 ECCENTRICITY    N     M S
1618 10 ELLIPTIC            V   S
1618 09 EQUATORIAL              S
1618 09 HEIGHT          N   V   S
1618 06 INCLINATION     N   V M S
1618 09 INVESTIGATION   N   V   S
1618 08 LIFETIME        N   V M
1618 09 MODEL               V   S
1618 08 MOTION            T   M
1618 06 NODE                V M S
1618 10 OBLATENESS      N
1618 10 ORBIT           N T V   S
1618 10 PERIGEE             V
```

1618	07	PREDICTION	N	T	V	M	S
1618	09	RATE					S
1618	06	REGRESSION	N		V	M	
1618	09	ROTATION	N		V	M	S
1618	10	SATELLITE	N	T		M	S
1618	08	SEMIMAJOR				M	S
1618	08	VARIATION			V		
1619	09	AIR			V		S
1619	05	ANGLE					S
1619	10	ATMOSPHERE	N	T			
1619	08	ATMOSPHERIC			V	M	S
1619	08	AXIS	N		V	M	S
1619	10	CONTRACTION	N		V	M	
1619	08	DAVTONIGHT	N		V		S
1619	10	DENSITY	N	T			S
1619	09	DETERMINATION	N		V		S
1619	08	DRAG			V	M	
1619	08	LATITUDE	N			M	S
1619	08	MODE				M	S
1619	10	ORBIT	N	T		M	
1619	08	PERIGEE	N		V	M	S
1619	10	RATE			V		S
1619	08	ROTATION	N		V		S
1619	10	SATELLITE		T	V		S
1619	08	SEASON	N				S
1619	06	SUN			V	M	S
1619	10	UPPER		T	V		S
1619	08	VARIATION			V	M	
1620	06	ABSORPTION			V	M	S
1620		ACCELERATION	N		V		S
1620	10	AIR			V		
1620	08	ALTITUDE	N			M	S
1620	10	ATMOSPHERE	N	T	V		S
1620	10	ATMOSPHERIC			V	M	S
1620	06	CENTIMETRE			V		S
1620	06	CONDUCTION	N			M	S
1620	06	CURVE	N		V	M	S
1620	10	DENSITY	N		V		S
1620	08	DIURNAL				M	S
1620	10	EARTH	N	T	V		
1620		ELECTROMAGNETIC	N		V		S
1620	06	HEAT			V		S
1620	08	INVERSION	N		V		S
1620	08	KILOMETRE			V		
1620	08	LAYER	N		V	M	S
1620	06	LOGARITHMIC				M	S
1620	09	MEASUREMENT	N			M	S
1620	06	RADIATION	N		V		S
1620	10	SATELLITE	N	T			
1620	08	SEASONAL			V	M	S
1620	06	SOLAR			V	M	S

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1620 08 TEMPERATURE                 V M S
1620 06 ULTRAVIOLET                 V M S
1620 10 UPPER                     T     S
1620 08 VARIATION               N   V   S
1621 08 ACTIVITY                N   V M S
1621 10 AIR                       T     S
1621 10 ALTITUDE                N   V M S
1621 10 ATMOSPHERE              N     M
1621 09 CALCULATION             N       S
1621 08 CURVE                   N   V
1621 08 DAYTIME                     V M
1621 10 DENSITY                 N T V M S
1621 10 DISCOVER
1621 10 DIURNAL                   T   M
1621 08 FLUX                          M S
1621 09 KILOMETRE                 T   M S
1621 10 LATITUDE                  T V   S
1621 08 LOGARITHMIC                 V M S
1621 08 NIGHTTIME                   V M S
1621 10 ORBIT                   N T     S
1621 06 PERIOD                        M
1621 06 REVOLUTION              N   V
1621 10 SATELLITE               N T V   S
1621 08 SOLAR                       V M S
1621 08 STANDARD                    V M S
1621 10 UPPER                           S
1621 10 VARIATION               N T
1622 06 AIR                         V M S
1622 08 ATLAS                   N     M
1622 10 ATMOSPHERE              N T V   S
1622 07 CHANGE                  N T V M S
1622 06 CONTRACTION             N   V   S
1622 09 DECREASE                N       S
1622 10 DENSITY                     V M S
1622 09 DISTANCE                N   V   S
1622 06 DRAG                    N   V M S
1622 10 ECCENTRICITY            N     M S
1622 08 EXPLORER                N   V   S
1622 09 HEIGHT                  N T V M S
1622 00 MEASUREMENT             N
1622 08 MIDAS                   N   V
1622 06 OBLATE                          S
1622 10 ORBIT                   N T V M S
1622 10 ORBITAL                         S
1622 10 PERIGEE                     V M S
1622 10 PERIOD                      V
1622 10 REVOLUTION                    M S
1622 10 SATELLITE                 T V M
1622 10 SCALE                     T
1622 09 SMALL                       V   S
1622 08 SPUTNIK                 N   V M
1622 05 TIME                    N       S
1622 10 UPPER                     T     S
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1622	05	VARIATION					S
1655	07	ANGLE			V	M	S
1655	07	ATTACK	N		V	M	S
1655	08	BLUNTED			V		
1655	10	BLUNTNESS	N	T	V		
1655	09	BODY	N	T		M	
1655	09	BOUNDARY		T	V		
1655	07	COEFFICIENT	N		V	M	S
1655	07	COMBINED			V	M	S
1655	08	CONE	N		V	M	S
1655	10	DISPLACEMENT	N	T		M	S
1655	09	DISTRIBUTION	N	T	V		
1655	10	EDGE		T	V		
1655	07	EFFECT	N	T	V		S
1655	08	FLAT			V	M	
1655	09	FLOW	N		V	M	S
1655	07	FORCE			V	M	S
1655	10	FRICTION	N	T	V	M	S
1655	09	HEAT		T	V		S
1655	09	HYPERSONIC		T	V		
1655	09	LAYER		T		M	
1655	10	LEADING		T	V	M	
1655	07	NORMAL			V		
1655	08	NOSED				M	
1655	08	PLATE	N		V	M	S
1655	09	PRESSURE		T			
1655	08	ROD	N		V	M	
1655	08	SHARP			V		S
1655	10	SKIN		T	V		
1655	09	SURFACE			V		S
1655	08	SWEEP	N		V	M	S
1655	09	THREEDIMENSIONAL			V		S
1655	09	TRANSFER	N	T	V	M	S
1655	09	TWODIMENSIONAL				M	S
1655	08	VISCOUS			V	M	S
1656	07	APPROXIMATE			V	M	S
1656	06	BLUNT			V	M	S
1656	00	CALCULATION	N		V	M	S
1656	06	CONDITION	N		V	M	
1656	08	CONICAL			V	M	S
1656	07	CONSTANT	N		V		S
1656	10	DEVIATION	N		V		S
1656	10	DISSOCIATING					
1656	10	DISSOCIATION	N	T	V	M	S
1656	06	DISTANCE	N		V		S
1656	08	EFFECT	N		V	M	S
1656	09	EQUATION	N		V	M	S
1656	10	EQUILIBRIUM	N	T		M	S
1656	06	FINITE			V		S
1656	09	FLOW	N		V	M	S
1656	08	FRACTION	N		V	M	S
1656	08	FREEZING			V		S

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1656 10 GAS                             N   V   S
1656 07 GRATE                                 M S
1656 09 HYPERSONIC                        T     S
1656 10 IDEAL                               V   S
1656 05 MODE                            N   V   S
1656 06 MOLECULAR                           V M S
1656 08 MOTION                          N   V M S
1656 08 NEARLY                              V   S
1656 10 NOZZLE                          N T     S
1656 07 NUMERICAL                             M S
1656 06 ONEDIMENSIONAL                          S
1656 06 PRESSURE                        N   V
1656 06 QUASI                               V M S
1656 07 RATE                                V   S
1656 06 RECOMBINATION                   N   V   S
1656 06 REDUCTED                            V   S
1656 08 RELAXATION                          V   S
1656 06 SECTION                         N   V   S
1656 06 SHOCK                               V M S
1656 07 SOLUTION                        N   V M
1656 06 STAGNATION                          V M S
1656 06 STANDOFF                            V M S
1656 06 TEMPERATURE                     N   V M S
1656 06 TUBE                            N   V M S
1656 06 TUNNEL                          N   V   S
1656 06 UPSTREAM                            V   S
1656 06 WAVE                            N   V M S
1656 06 WIND                                V   S
1656 06 WORKING                             V   S
1666 09 ANALYSIS                        N   V M S
1666 08 BEHIND                              V
1666 10 BLUNT                             T V M
1666 10 BODY                            N T V M S
1666 08 BOUNDARY                            V
1666 08 CURVATURE                       N   V   S
1666 08 DATA                            N       S
1666 09 DETERMINATION                       V M S
1666 05 DIFFERENTIAL                        V M S
1666 06 ENERGY                              V M S
1666 06 ENTROPY                             V M S
1666 05 EQUATION                        N   V M S
1666 08 EXPERIMENTAL                        V
1666 08 FIELD                               V
1666 08 FLOW                            N   V M S
1666 06 GRADIENT                        N     M
1666 09 HEAT                              T V M S
1666 09 HYPERSONIC                        T V   S
1666    LOW                               T V M S
1666 06 MOMENTUM                            V   S
1666 08 NOSE                                V M
1666 09 NUMBER                          N T V   S
1666 06 POINT                           N   V
1666 08 REGION                          N   V   S
1666 09 REYNOLDS                          T V   S
1666 08 SHEAR                               V M S
1666 08 SHOCK                           N   V M S
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1666	09	SPEED	N	T	V		S
1666	06	SPHERICAL			V		
1666	06	STAGNATION			V		S
1666		TRANSFER	N	T	V	M	S
1666	06	VORTICITY	N		V	M	S
1666	08	WALL	N		V	M	S
1667	10	AXISYMMETRIC			V		S
1667	07	BEHIND			V		S
1667	09	BOUNDARY					
1667	08	CONDUCTION	N		V	M	S
1667	08	CONTINUUM			V		S
1667	06	COOLING	N		V		
1667	08	DISTANCE	N		V		S
1667	05	DOMAIN	N		V	M	S
1667	08	EFFECT	N		V		
1667	06	ENTHALPY			V	M	S
1667	09	FLOW	N		V	M	
1667	06	FREE			V		
1667	06	FRICTION	N		V		S
1667	06	FUNCTION	N		V	M	S
1667	08	HEAT				M	S
1667	08	HUGONIOT			V		S
1667	09	HYPERSONIC		T	V		S
1667	05	INCIPIENT			V		
1667	08	INTERACTION			V	M	S
1667	10	LAYER	N	T	V		S
1667	06	LIMIT	N		V		S
1667	10	LOW		T	V	M	S
1667	05	MERGED			V	M	S
1667	06	MOLECULE			V		
1667	09	NUMBER	N	T	V	M	S
1667	07	ONE	N		V	M	S
1667	08	PROCESS	N		V	M	S
1667	06	PROFILE	N		V	M	
1667	08	RANKINE			V	M	S
1667	07	RATE	N		V		S
1667	07	REGIME	N			M	S
1667	10	REGION	N	T			S
1667	08	RELATION	N		V	M	S
1667	10	REYNOLDS		T	V	M	S
1667	10	SHOCK	N	T	V		S
1667	06	SKIN			V	M	S
1667	10	STAGNATION		T		M	S
1667	08	STANDOFF			V		S
1667	06	STRONG			V	M	S
1667	06	SURFACE			V		S
1667	09	THEORY	N	T	V		S
1667	09	THIN			V	M	S
1667	08	TRANSFER	N		V	M	S
1667	05	TRANSITION			V	M	S
1667	08	TRANSPORT				M	S
1667	07	TWO	N		V		S
1667	06	VELOCITY			V	M	S
1667	08	VISCOUS					S
1667	08	VORTICITY			V	M	
1667	06	ZONE	N		V	M	S

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1670 09 ANALYTICAL          V M S
1670 10 BLUNT             T V
1670 10 BODY            N T V M S
1670 09 DENSITY             V   S
1670 09 HYPERSONIC        T   M
1670 09 LOW               T V M
1670 09 NUMBER          N T V M
1670 10 POINT               V
1670 09 RESULT          N   V   S
1670 10 REYNOLDS          T V M S
1670 10 STAGNATION          V   S
1670 09 TRANSFER        N T     S
1670 06 VAPOUR                M
1670 08 VORTICITY       N   V M S
1671 08 AERODYNAMIC         V M S
1671 09 BOUNDARY          T V   S
1671 08 CENTRE              V   S
1671 07 CHARACTERISTIC  N   V   S
1671 05 COEFFICIENT     N       S
1671 06 DISPLACEMENT          M
1671 07 DISTRIBUTION    N   V M S
1671 08 DRAG            N   V   S
1671 07 EFFECT          N   V M S
1671 06 FORCE           N   V   S
1671 06 FORM                V M S
1671 08 GROWTH          N   V   S
1671 08 HEAD                V M S
1671 09 LAYER           N T V
1671 08 LIFT            N   V   S
1671 09 MEASUREMENT     N T V M S
1671 06 MOMENT          N   V M
1671 06 MOMENTUM            V M S
1671 05 NORMAL              V M S
1671 05 PARAMETER       N   V M S
1671 10 PERCENT             V M S
1671 06 PITCHING            V   S
1671 07 PREDICTION            M S
1671 09 PRESSURE          T V   S
1671 10 SECTION         N   V M S
1671 08 STATIC              V
1671 09 SUBSONIC            V M S
1671 06 TANGENTIAL          V   S
1671 06 THICKNESS       N   V   S
1671 07 TOTAL               V   S
1671 08 TRANSITION      N   V M S
1671 09 TRAVERSE        N     M S
1671 09 TUNNEL          N   V   S
1671 07 TURBULENT           V M S
1671 10 TWODIMENSIONS       V   S
1671 08 VELOCITY            V
1671 08 VISCOSITY           V M S
1671 09 WIND                V M S
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1671	10	WING	N	T	V	M	S
1672	05	AEROFOIL	N		V	M	S
1672	06	AIR	N		V	M	S
1672	05	AIRCRAFT	N		V		S
1672	05	ANGLE			V	M	S
1672	06	ASPECT			V	M	S
1672	08	BLOCKAGE	N		V	M	S
1672	06	BODY			V	M	S
1672	07	BOUND			V	M	S
1672	10	BOUNDARY			V	M	S
1672	05	BUMP	N		V		S
1672	05	CALCULATION	N		V		S
1672	06	CAMBER			V	M	S
1672		CHOKING	N		V		SA
1672	08	CIRCULAR			V	M	S
1672	09	CLOSED			V		S
1672	05	COEFFICIENT	N		V		S
1672	05	COMPLETE			V	M	S
1672	06	CONDENSATION			V	M	S
1672	09	CONDITION	N		V	M	S
1672	10	CONSTRAINT	N		V		S
1672	06	CONTROL	N		V	M	S
1672	08	CORRECTION	N				S
1672	06	CURVATURE	N		V		S
1672	06	DISTURBANCE	N		V		S
1672	06	DOWNSTREAM			V	M	S
1672	07	DRAG				M	S
1672	06	DRIERS	N		V	M	S
1672	05	DRY			V	M	S
1672	10	EFFECT	N	T	V	M	S
1672	06	FINITE			V		
1672	07	FLOW	N				S
1672	06	FREESTREAM			V		S
1672	06	GAS	N		V	M	S
1672	06	GRADIENT	N		V		S
1672	05	GROUND			V		S
1672	07	HIGH			V		S
1672	06	HUMIDITY	N		V	M	S
1672	05	INCIDENCE			V		S
1672	07	INDUCED			V	M	S
1672	10	INTERFERENCE	N	T	V	M	S
1672	08	JET			V	M	S
1672	06	LAYER			V	M	S
1672	08	LIFT				M	
1672	06	LIFTING			V		S
1672	05	LINE			V	M	S
1672	06	LIQUEFACTION			V		S
1672	05	LOCKHEED			V		S
1672	07	MACH			V	M	S
1672	06	MASS			V		S
1672	05	METHOD	N		V	M	S
1672	08	MODEL	N		V		S
1672	06	MOISTURE			V	M	S
1672	05	NEAR			V		
1672	06	NONPERFECT			V	M	S
1672	06	NUMBER	N		V	M	S

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                                              M S
1672 08 OCTAGONAL                           V   S
1672 08 OPEN                            N   V M S
1672 06 POINT                           N   V   S
1672 06 PRESSURE                            V M S
1672 05 PROFILE                         N     M S
1672 06 PROPELLER                           V M S
1672 05 RATIO                               V   S
1672 08 RECTANGULAR                         V M S
1672 06 RELAXATION                      N   V M S
1672 06 REVOLUTION                          V M S
1672 06 RIGID                               V   S
1672 06 SATURATION                      N   V M S
1672 09 SECTION                         N   V   S
1672 06 SETTING                             V   S
1672 08 SOLID                           N   V M S
1672 05 SOLUTION                            V M S
1672 06 SPAN                                V   S
1672 08 SPANNING                        N   V M S
1672 07 SPEED                               V M S
1672 06 STATIC                              V   S
1672 05 STRAIGHT                            V M S
1672 06 STREAMLINE                          V M S
1672 06 SUBSONIC                            V   S
1672 07 SUPERSONIC                          V   S
1672 05 SYSTEM                              V M S
1672 06 TAIL                            N   V M S
1672 05 TAILPLANE                       N       S
1672 06 TEMPERATURE                     N   V M S
1672 07 TEST                            N   V   S
1672 07 TESTING                             V M S
1672 06 THREEDIMENSIONAL                    V   S
1672 09 THROAT                              V M S
1672 06 TIME                            N T V   S
1672 10 TUNNEL                              V M S
1672 06 TWODIMENSIONAL                  N   V M S
1672 06 UNITY                           N   V   S
1672 07 VELOCITY                        N   V   S
1672 06 VORTEX                              V   S
1672 08 WAKE                            N   V M S
1672 10 WALL                              T V M S
1672 10 WIND                            N   V   S
1672 08 WING                                V   S
1672 09 WORKING                             V M
1672 06 ZERO                                    S
1675 06 AERODYNAMIC                         V   S
1675 07 BOUNDARY                        N   V M S
1675 06 CENTRE                              V M
1675 09 CHORDWISE                         T V   S
1675 10 CURVED                            T V M
1675 09 DEGREE                          N     M S
1675 08 DISPLACEMENT                    N T V M S
1675 09 DISTRIBUTION                        V   S
1675 08 EDGE                            N   V M
1675 07 EFFECT                          N T   M S
1675 09 FLOW                            N   V   S
1675 09 INCIDENCE
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1675	08	ISOBAR	N		V	M	S	
1675	07	LAYER			V		S	
1675	08	LEADING			V			
1675	08	LIFT	N		V	M	S	
1675	07	LOCAL			V		S	
1675	08	LOCATION			V		S	
1675	08	LONGITUDINAL				M	S	
1675	07	MAIN			V		S	
1675	09	MEASUREMENT	N		V	M		
1675	08	OIL			V	M	S	
1675	07	ONSET	N				S	
1675	07	PART				M	S	
1675	08	PATTERN	N		V		S	
1675	09	PERCENT		T	V	M	S	
1675	10	PLANFORM	N		V	M	S	
1675	09	PRESSURE	N	T	V	M		
1675	10	RAE			V		S	
1675	10	RAE			V	M	S	
1675	07	REARWARD			V	M		
1675	08	ROUGHNESS	N			M	S	
1675	08	SCALE			V		S	
1675	07	SECONDARY			V	M	S	
1675	09	SECTION	N		V			
1675	09	SEPARATION	N		V		S	
1675	07	SPAN			V	M	S	
1675	06	SPANWISE			V	M		
1675	08	STABILITY	N		V	M	S	
1675		STALL	N		V	M		
1675	08	STALLING	N		V	M	S	
1675	10	STREAMWISE			V	M	S	
1675	07	STRENGTH	N		V	M	S	
1675	09	SUBSONIC			V			
1675	09	TUNNEL					S	
1675	07	TURBULENT					S	
1675	08	VORTEX	N		V	M	S	
1675	09	WIND			V	M	S	
1675	08	SUCTION	N		V	M	S	
1675	09	SURFACE		T	V		S	
1675	10	SWEEPBACK		T	V		S	
1675	10	THICK		T	V	M	S	
1675	10	TIP		T	V		S	
1675	08	TRAILING			V		S	
1675	08	TRANSITION	N		V	M	S	
1675	10	WING		T	V	M	S	
1676	07	ASPECT		T	V		S	A
1676	09	CALCULATION	N		V	M	S	A
1676	07	CENTRE				M	S	A
1676	10	CHORDWISE		T	V	M	S	A
1676	09	COMPRESSIBLE			V		S	A
1676	08	DOWNWASH	N		V	M		A
1676	08	DRAG	N		V		S	A
1676	09	FLOW	N		V	M	S	A
1676	07	INDUCED			V	M	S	A
1676	07	INFINITE			V	M		A
1676	08	LIFT	N		V	M		A
1676	10	LIFTING				M	S	A

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1676 10 LOADING                     N T   M  A
1676 07 NONLINEAR                       V M SA
1676 07 RATIO                         T V M  A
1676 05 SECTIONAL                       V   SA
1676 05 SLOPE                             M SA
1676 10 SPANWISE                      T V   SA
1676 09 STRAIGHT                      T V    A
     1676 09 SUBSONIC                 T V M S    A
1676 10 SURFACE                         V   SA
1676 10 SWEPT                         T V   SA
1676 09 THEORY                      N   V    A
1676 07 THICK                           V M  A
1676 09 THIN                            V M SA
1676 08 TRAILING                          M SA
1676 10 UNCAMBERED                        M SA
1676 07 UNIFORM                           M SA
1676 08 VORTEX                      N     M SA
1676 10 WING                        N T V M SA
1677 05 AERODYNAMIC                     V M  A
1677 06 ASPECT                          V M SA
1677 10 CALCULATING                 N T   M  A
1677 07 CALCULATION                 N   V   SA
1677 06 CENTRAL                         V   SA
1677 08 CHORDWISE                   N   V   SA
1677 06 CIRCULAR                        V    A
1677 06 COMPRESSIBILITY             N   V M SA
1677 09 COMPUTER                    N       SA
1677 06 DELTA                           V    A
1677 10 DISTRIBUTION                N T V M SA
1677 08 DOWNWASH                        V M SA
1677 06 DRAG                        N   V M SA
1677 08 EQUATION                    N   V M SA
1677 07 EXPERIMENT                  N     M SA
1677 06 FLAP                        N   V    A
1677 06 FORCE                             M  A
1677 06 INDUCED                         V   SA
1677 06 INFINITE                            SA
1677 08 INTEGRAL                        V M SA
1677 10 LIFT                          T V   SA
1677 10 LIFTING                       T V    A
1677 08 LINEAR                          V   SA
1677 10 LOAD                            V   SA
1677 09 METHOD                        T     SA
1677 06 MIDDLE                          V   SA
1677 06 MOMENT                      N   V M  A
1677 06 PIVOTAL                           M SA
1677 06 PLANFORM                        V M SA
1677 06 POINT                       N   V M SA
1677 08 PRACTICAL                       V M SA
1677 06 RATIO                             M  A
1677 06 ROUNDINGOFF                     V M SA
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1677 06 RULE                  N   V M SA
1677 06 SECTION               N   V M SA
1677 07 SOLUTION              N   V   SA
1677 08 SPANWISE              N   V M SA
1677 10 SUBSONIC                T V   SA
1677 10 SURFACE               N T V M SA
1677 06 SWEPT                     V   SA
1677 08 TABLE                     V   SA
1677 09 THEORY                N T V M SA
1677 10 WING                  N T V M SA
1680 09 ANALYSIS              N   V M SA
1680 09 COMPRESSIBLE                M SA
1680 08 DEFLECTED                 V M SA
1680 07 DIFFERENTIALLY            V   SA
1680 07 DISTRIBUTION          N   V M SA
1680 10 EDGE                  N   V M  A
1680 09 EQUATION              N   V   SA
1680 10 FIELD                NN T   M SA
1680 09 FLOW                  N T V M SA
1680 09 INTEGRAL                  V M  A
1680 10 LEADING                   V   SA
1680 08 LIFTING                   V M SA
1680 09 LINEARIZED                V M SA
1680 08 LOADING                       SA
1680 08 PARABOLIC                   M SA
1680 00 PITCHING                  V   SA
1680 07 PRESSURE                  V M SA
1680 10 QUASICONICAL              V M SA
1680 07 RELATION                  V M SA
1680 08 ROLLING                   V   SA
1680 08 SHAPE                 N   V M SA
1680 09 SUBSONIC                  V   SA
1680 09 SUPERSONIC              T V M SA
1680 08 SURFACE                   V M SA
1680 07 SYMMETRICAL               V M SA
1680 08 THICKNESS                   M  A
1680 10 TRIANGULAR                V M SA
1680 08 TWIST                 N   V    A
1680 06 UPWASH                        SA
1680 10 VELOCITY                    M SA
1680 10 WING                  N T V M SA
1680 08 YAWED                     V M SA
1681 06 ABEL                          SA
1681 05 AEROFOIL                  V M  A
1681 07 ANGLE                     V M SA
1681 07 ATTACK                N   V M SA
1681 07 BODY                  N   V M SA
1681 08 CAMBER                N   V   SA
1681 07 COMBINED                      SA
1681 08 CONICAL                   V   SA
1681 07 CONVEX                    V M SA
1681 08 DEFLECTED                 V M SA
1681 07 DIFFERENTIALLY            V M SA
1681 08 DISCONTINUITY             V   SA
1681 09 DISTRIBUTION          N     M SA
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1681 10 DOUBLET         V   SA
1681 07 DRAG                V M  A
1681 08 EDGE            N   V   SA
1681 07 EDGED               V   SA
1681 07 ELEMENT         N   V   SA
1681 09 ELEMENTARY          V   SA
1681 10 EQUATION        N T V M SA
1681 07 FIELD           N   V   SA
1681 06 FINITE              V M SA
1681 07 FLAT                V M SA
1681 09 FLOW            N   V M SA
1681 10 HORSESHOE           V M SA
1681 09 INDUCED             V   SA
1681 10 INTEGRAL          T     SA
1681 08 INVERSION       N   V   SA
1681 08 LEADING                 SA
1681 08 LIFTING             V M SA
1681 09 LINEARIZED        T V M SA
1681 08 LOAD                V M SA
1681 08 LOADING         N   V M SA
1681 06 MACH                V M SA
1681 06 MULTIPLE            V   SA
1681 08 NONLIFTING          V M SA
1681 06 PART            N   V M SA
1681 10 PERTURBATION        V M SA
1681 07 PLANE               V M SA
1681 07 PLATE           N   V M SA
1681 09 POTENTIAL       N   V   SA
1681 09 PRESSURE        N   V M SA
1681 08 QUASICONICAL        V M SA
1681 07 RECTANGULAR         V   SA
1681 06 REFLECTION          V M SA
1681 07 REVERSIBILITY         M SA
1681 07 SECTION         N   V   SA
1681 07 SHAPE           N   V M SA
1681 08 SHARP               V   SA
1681 05 SINGULAR            V M SA
1681 07 SLENDER             V   SA
1681 10 SOURCE              V M SA
1681 09 SUBSONIC            V   SA
1681 09 SUPERSONIC          V M SA
1681 08 SURFACE         N       SA
1681 06 SWEPTFORWARD          M SA
1681 07 SYMMETRICAL         V    A
1681 07 THEOREM         N   V M SA
1681 09 THEORY          N T V   SA
1681 08 THICKNESS       N   V M  A
1681 06 TIP             N   V M SA
1681 08 TRIANGULAR          V M SA
1681 08 TWIST           N   V M SA
1681 07 UPPER               V M  A
1681 10 VELOCITY        N   V   SA
1681 09 VERTICAL              M SA
1681 10 VORTEX              V M SA
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1681 06 WAVE                            N   V M SA
1681 10 WING                            N T V M SA
1682 09 ANTISYMMETRIC                         M SA
1682 09 CALCULATION                     N   V   SA
1682 10 CAMBERED                          T V M SA
1682 10 CONICAL                               M SA
1682 09 DISTRIBUTION                    N   V M SA
1682 10 DOWNWASH                            V    A
1682 10 EDGE                            N   V M SA
1682 09 EQUATION                        N   V   SA
1682 09 FLOW                            N T V M SA
1682 06 FLUTTER                         N     M SA
1682 09 GENERALIZED                         V M SA
1682 09 INTEGRAL                            V    A
1682 10 LEADING                             V M SA
1682 10 LIFT                              T   M  A
1682 09 POTENTIAL                       N       SA
1682 09 SUBSONIC                            V   SA
1682 09 SUPERSONIC                        T V M SA
1682 09 SYMMETRIC                             M SA
1682 09 THEORY                          N   V M SA
1682 06 TRANSONIC                           V    A
1682 10 TWISTED                           T     SA
1682 09 VELOCITY                            V M  A
1682 09 WING                            N T V    A
1683 10 ATTACHMENT                      N T   M SA
1683 07 CALCULATION                     N   V M SA
1683 10 CAMBER                          N T V M SA
1683 10 CONICAL                           T V    A
1683 10 DELTA                             T V   SA
1683 09 DEPENDENT                         T V    A
1683 08 DISTRIBUTION                    N   V    A
1683 10 DRAG                            N T   M  A
1683 10 EDGE                            N T V M  A
1683 06 FLAP                            N     M SA
1683 08 FLOW                              T V M  A
1683 06 HINGED                              V M  A
1683 10 LEADING                           T   M SA
1683 10 LIFT                              T     SA
1683 07 LINE                            N   V    A
1683 08 LINEARIZED                            M SA
1683 08 LOAD                                V   SA
1683 06 MACH                                V   SA
1683 05 NEARLY                              V M SA
1683 05 NUMBER                          N     M SA
1683 10 SEPARATION                      N   V M  A
1683 06 SHAPE                           N   V   SA
1683 08 SLENDER                             V    A
1683 09 SONIC                             T V M SA
1683 09 SPEED                           N T V M SA
1683 09 SUBSONIC                            V   SA
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1683	06	SUCTION	N		V	M		A
1683	09	SUPERSONIC		T	V	M		A
1683	09	THEORY	N				S	A
1683	09	THIN						A
1683	06	UPWASH				M		A
1683	08	VANISHING			V		S	A
1683	10	WING	N	T	V		S	A
1684	06	AXIS	N			M	S	A
1684	09	COMPLETE			V	M	S	A
1684	10	ELLIPTIC		T	V	M	S	A
1684	06	GRAVITY			V	M	S	A
1684	06	GYROSCOPIC			V		S	A
1684	05	INFLUENCE					S	A
1684	10	INTEGRAL	N	T	V		S	A
1684	06	MOTION	N		V	M	S	A
1684	06	PARTICLE	N		V	M	S	A
1684	06	PENDULUM	N		V	M		A
1684	06	REACTION	N		V	M		A
1684	06	REVOLUTION			V	M		A
1684	06	SMOOTH			V		S	A
1684	05	SOLUTION	N		V		S	A
1684	06	SPHERICAL			V		S	A
1684	06	SURFACE			V		S	A
1684	09	TABLE	N	T	V		S	A
1684	06	VERTICAL			V	M	S	A
1687	07	AERODYNAMIC			V	M		A
1687	10	AEROFOIL	N	T	V	M	S	A
1687	07	CENTRE	N		V		S	A
1687	08	CHORD					S	A
1687	07	COEFFICIENT	N		V	M	S	A
1687	08	CONVEX			V	M	S	A
1687	08	DAMPING			V		S	A
1687	09	DISTRIBUTION	N				S	A
1687	09	FLOW	N		V	M	S	A
1687	09	FORMULA	N		V		S	A
1687	10	OSCILLATION	N		V	M	S	A
1687	08	PISTON			V		S	A
1687	10	PITCHING			V	M	S	A
1687	09	PRESSURE				M	S	A
1687	07	RATIO	N		V		S	A
1687	09	SUPERSONIC				M	S	A
1687	09	SYMMETRICAL			V	M	S	A
1687	07	THEORY	N		V	M	S	A
1687	08	THICKNESS			V		S	A
1687	10	TWODIMENSIONAL			V		S	A
1688	09	AERODYNAMIC		T		M		
1688	10	ANGLE		T		M	S	
1688	10	ATTACK	N	T			S	
1688	05	BEHIND			V	M	S	

1688	08	BLUNTNESS	N			M	
1688	10	BODY	N	T	V		S
1688	10	CIRCULAR			V	M	S
1688	09	CLOSED			V	M	S
1688	09	COEFFICIENT	N	T			S
1688	10	CONE	N			M	S
1688	05	CONTRIBUTION	N		V	M	S
1688	08	CROSS			V	M	S
1688	07	DATA	N	T		M	S
1688	10	DERIVATIVE	N			M	S
1688	10	DRAG			V		S
1688	06	EDGE			V		S
1688	10	ELLIPTIC			V		S
1688	07	EXPERIMENTAL		T	V	M	S
1688	09	EXPRESSION	N	T	V	M	S
1688	09	FLOW	N		V	M	S
1688	10	FORCE	N		V	M	S
1688	06	FOREBODY			V	M	
1688	09	FORM			V	M	
1688	10	HYPERSONIC		T			
1688	06	INTERFERENCE	N				S
1688	06	LEADING			V	M	
1688	06	LEEWARD			V	M	S
1688	10	LIFT			V	M	S
1688	10	LONGITUDINAL					
1688	10	MOMENT				M	S
1688	10	NEWTONIAN		T	V	M	S
1688	05	NORMAL			V		S
1688	08	NOSE				M	S
1688	10	PITCHING			V		S
1688	00	PREDICTION	N				S
1688	05	PRESSURE			V	M	S
1688	05	REDUCTION	N		V		S
1688	10	REENTRY			V		S
1688	10	REVOLUTION				M	S
1688	08	SECTION	N		V	M	S
1688	10	SEGMENT	N				S
1688	06	SHOCK	N		V	M	S
1688	10	SIDESLIP	N	T		M	S
1688	08	SLOPE	N				S
1688	10	SPHERICAL			V		S
1688	10	STABILITY					
1688	06	STAGNATION			V		
1688	10	STATIC				M	S
1688	08	SURFACE				M	S
1688	09	TABULATION	N				S
1688	10	VEHICLE	N				
1688	06	VISCOUS			V	M	
1691	10	AIR	N	T	V	M	S
1691	10	BURNED		T	V		
1691	09	CALCULATION	N	T	V	M	S
1691	10	COMBUSTION		T	V	M	S
1691	10	COMPOSITION	N		V		S
1691	09	COMPOUND					S
1691	08	CONDUCTIVITY	N				S
1691	07	CONSTANT	N				S

1691	08	DENSITY	N		V	M	S
1691	10	DISSOCIATED			V	M	S
1691	08	ENTHALPY	N			M	S
1691	08	ENTROPY	N				
1691	10	EQUILIBRIUM			V		
1691	08	EQUIVALENCE			V	M	S
1691	10	ETHYLENE	N	T		M	S
1691	07	EXPONENT	N				
1691	08	FLAME			V	M	S
1691	09	FLOW		T	V	M	
1691	10	FUEL	N	T	V	M	S
1691	10	GAS	N				
1691	07	HEAT	N		V	M	S
1691	10	HYDROCARBON		T	V		S
1691	08	ISENTROPIC			V	M	
1691	10	METHANE	N	T		M	
1691	09	MIXED			V		S
1691	10	NOZZLE					S
1691	07	NUMBER	N				
1691	09	ORDINATE	N		V		S
1691	08	PRANDTL			V		S
1691	07	PRESSURE	N		V	M	
1691	09	PRODUCT		T	V		
1691	09	PROPERTY	N	T	V		
1691	07	RATIO	N				S
1691	07	SPECIFIC			V	M	S
1691	10	SUPERSONIC			V		S
1691	07	TEMPERATURE	N			M	S
1691	07	THERMAL			V		S
1691	09	THERMODYNAMIC		T	V	M	
1691	10	TRANSPORT		T	V		S
1691	08	VISCOSITY	N			M	S
1692	07	CENTRE				M	S
1692	10	CHOKED				M	S
1692	10	CONVERGENT			V	M	S
1682	10	DELTA			V	M	SA
1692	07	DISTRIBUTION	N		V	M	S
1692	09	DOWNSTREAM		T	V	M	
1692	06	EXHAUST			V		
1692	10	EXIT	N	T	V	M	S
1692	07	EXTERNAL			V	M	S
1692	10	FLAT		T	V		S
1692	09	FLOW			V	M	S
1692	08	GROSS			V	M	S
1692	06	HELIUM			V	M	
1692	06	HOT			V		S
1692	08	INCREMENTAL			V		S
1692	08	INTERACTION				M	S

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1692 10 JET                            N T
1692 08 LIFT                                   S
1692 07 LOCATION                           V
1692 09 MACH                           N T     S
1692 10 NACELLE                          T V M S
1692 10 NOZZLE                         N
1692 09 PRESSURE                       N   V M
1692 10 PROPULSIVE                         V M S
1692 07 RATIO                          N   V   S
1692 07 RELATION                           V M S
1692 08 SHOCK                              V M S
1692 09 SIMULATED                        T V M S
1692 05 SIMULATION                     N   V   S
1692 09 STATIC                             V M S
1692 09 SUPERSONIC                         V M S
1692 09 SURFACE                        N T V   S
1692 09 SURVEY                         N   V M S
1692 07 TEST                           N     M S
1692 08 THRUST                         N     M
1692 10 TURBOJET                         T V M S
1692 08 WAKE                           N   V   S
1692 08 WAVE                                 M S
1692 10 WING                               V M
1693 10 ANGLE
1693 10 ATTACK                         N     M S
1693 08 BLOWDOWN                           V   S
1693 10 CHOKED                             V M
1693 07 COEFFICIENT                    N     M S
1693 10 CONVERGENT                         V M S
1693 07 DISTRIBUTION                   N   V   S
1693 10 DIVERGENT                          V M S
1693 10 DOWNSTREAM                       T V M S
1693 08 EXHAUST                        N   V M S
1693 10 EXIT                             T   M S
1693 10 FLAT                             T V   S
1693 09 FLOW                               V
1693 08 FORCE                              V M S
1693 06 HELIUM                             V M S
1693 06 HOT                                V
1693 08 INCREMENT                              S
1693 08 INDUCED                            V M S
1693 10 JET                            N T V   S
1693 08 LIFT                           N   V   S
1693 07 LOCATION                       N
1693 09 MACH                           N T   M S
1693 10 NACELLE                          T V M
1693 07 NORMAL                                 S
1693 10 NOZZLE                         N   V M S
1693 09 PRESSURE                           V M S
1693 10 PROPULSIVE                         V M S
1693 07 RATIO                          N     M
1693 08 SHOCK                              V M S
1693 09 SIMULATED                        T V   S
1693 06 SIMULATION                     N     M S
1693 06 SONIC                              V   S
1693 09 STATIC                               M S
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1693	09	SUPERSONIC			V	M	S
1693	09	SURFACE	N	T		M	S
1693	09	SURVEY	N		V	M	
1693	07	TEST	N			M	S
1693	07	TOTAL			V	M	S
1693	07	TUNNEL			V	M	S
1693	10	TURBOJET		T	V	M	S
1693	08	WAVE			V	M	S
1693	10	WING				M	
1693	09	ZERO			V		S
1694	09	ANGLE	N		V	M	S
1694	06	APEX			V	M	
1694	09	ATTACK	N		V	M	S
1694	10	CHOKED				M	S
1694	05	COEFFICIENT	N			M	S
1694	10	CONVERGENT				M	S
1694	09	DISTRIBUTION	N	T	V	M	S
1694	10	DIVERGENT				M	S
1694	08	EXHAUST		T	V	M	S
1694	10	EXHAUSTING					
1694	08	EXIT			V	M	
1694	10	FLAT		T		M	S
1694	09	FLOW			V	M	S
1694	08	FORCE	N			M	
1694	08	INCREMENTAL					S
1694	08	INDUCED		T	V	M	S
1694	10	JET	N	T	V		S
1694	08	LIFT	N		V		S
1694	07	LOCATION	N		V	M	
1694	09	MACH	N	T	V	M	S
1694	08	NACELLE			V		S
1694	07	NORMAL				M	S
1694	10	NOZZLE	N		V		
1694	10	PLATE		T	V	M	S
1694	09	PRESSURE		T	V		S
1694	10	PROPULSIVE			V		S
1694	07	RATIO	N			M	S
1694	10	SHOCK				M	
1694	10	SONIC		T	V	M	S
1694	09	SUPERSONIC		T	V	M	S
1694	09	SURFACE	N				S
1694	09	TEST	N		V	M	S
1694	06	THRUST			V	M	S
1694	07	TOTAL			V		
1694	08	TURBOJET			V		
1694	10	WAVE					
1694	10	WING			V		S
1694	09	ZERO			V	M	S
1695	08	AIR	N		V	M	S
1695	09	ANGLE			V		S
1695	09	ATTACK	N		V	M	S
1695	09	BLOWDOWN				M	S
1695	08	BURNED					S

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1695 08 CARBON                    V M S
1695 08 COLD                      V M S
1695 07 COMPOSED                  V M S
1695 08 DENSITY               N   V M S
1695 08 DIOXIDE               N   V M S
1695 09 DISTRIBUTION          N   V M S
1695 08 EXHAUST                   V M S
1695 10 EXHAUSTING                  M S
1695 08 EXIT                      V   S
1695 10 FLAT                        M S
1695 09 FLOW                      V M S
1695 08 GAS                       V M S
1695 08 HEAT                  N     M S
1695 08 HELIUM                    V M S
1695 08 HOT                     T V M S
1695 08 HYDROGEN                      S
1695 10 INTERFERENCE          N   V M S
1695 10 JET                   N T V   S
1695 09 MACH                  N T   M S
1695 08 MIXTURE                   V
1695 10 NACELLE               N   V M S
1695 09 PRESSURE                  V   S
1695 10 PROPULSIVE                V   S
1695 00 RATIO                 N   V
1695 10 SHOCK                     V M
1695 09 SIMULATED                 V   S
1695 10 SONIC                       M S
1695 08 SPECIFIC                      S
1695 07 STATIC                    V   S
1695 09 SUPERSONIC                  M S
1695 10 SURFACE                 T   M S
1695 07 SURVEY                N   V
1695 09 TEST                  N   V M S
1695 09 TUNNEL                    V M S
1695 10 TURBOJET                  V   S
1695 08 VELOCITY              N   V M S
1695 10 WAVE                        M S
1695 10 WING                  N   V M S
1695 09 ZERO                      V   S
1696 08 AXIALLY                   V M S
1696 09 BENEATH                   V M
1696 07 BOUNDARY                  V M S
1696 07 CENTRE                    V M
1696 10 CHAMBER                   V M S
1696 07 CHORDWISE                 V M
1696 07 COEFFICIENT               V
1696 07 COORDINATE                V M S
1696 09 DIAMETER              N   V M S
1696 09 DIRECTION               T V M
1696 10 EXHAUSTING              T V   S
1696 10 FLAT                    T   M S
1696 09 FLOW                    T V M S
1696 08 FORCE                 N   V M S
1696 09 FREE                    T V M
1696 08 INCREMENTAL               V M
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1696	08	INTERFERENCE	N		V		
1696	10	JET	N	T			S
1696	07	LAYER					S
1696	10	LOAD	N	T	V		S
1696	09	MACH	N	T	V		
1696	08	NORMAL				M	S
1696	08	NOZZLE			V		S
1696	10	PLATE		T	V	M	
1696	09	POSITION	N		V	M	
1696	09	PRESSURE	N	T			S
1696	09	RATIO			V	M	S
1696	10	ROCKET		T	V	M	S
1696	08	SEPARATION	N			M	
1696	08	SONIC			V	M	S
1696	09	SPANWISE		T	V	M	S
1696	09	STATIC			V	M	
1696	09	STREAM		T	V	M	S
1696	09	SUPERSONIC			V	M	S
1696	08	SYMMETRIC			V		S
1696	10	THROAT			V	M	
1696	08	THRUST	N		V	M	S
1696	09	TOTAL					S
1696	08	TWODIMENSIONAL				M	S
1696	09	VERTICAL				M	S
1696	10	WING	N	T	V	M	S
1697	09	DISTRIBUTION	N		V		S
1697	10	DOWNSTREAM				M	S
1697	10	EXHAUST	N		V	M	S
1697	10	FIRING	N	T			S
1697	10	FLAT				M	S
1697	09	FLOW			V		S
1697	08	FORCE			V	M	S
1697	10	INTERFERENCE			V		S
1697	10	JET		T		M	
1697	08	LOCATION	N		V	M	S
1697	09	MACH	N		V	M	S
1697	09	MEASUREMENT	N		V		S
1697	07	NORMAL			V		S
1697	10	PLATE					S
1697	09	PRESSURE				M	
1697	10	ROCKET		T		M	
1697	08	SHADOWGRAPH			V	M	S
1697	09	SUPERSONIC				M	S
1697	08	THRUST	N			M	S
1697	10	UPSTREAM					S
1697	10	WING	N		V	M	S
1698	06	ACCELERATION	N		V	M	S
1698	09	AERODYNAMIC			V	M	S
1698	09	ANGLE			V		S
1698	09	ASPECT		T	V	M	S
1698	09	ATTACK	N		V	M	S
1698	09	CALCULATION	N		V	M	

1698	07	CONTINUOUS			V		
1698	08	DOWNWASH	N		V	M	S
1698	08	EDGED			V		S
1698	07	FINAL			V		
1698	10	FINITE		T	V		S
1698	08	GUST	N		V	M	S
1698	08	INDICIAL				M	S
1698	09	INERTIA	N			M	
1698	09	INFINITE			V	M	S
1698	10	LIFT	N	T	V		S
1698	06	LOADED			V		
1698	08	OSCILLATION	N		V	M	S
1698	08	PENETRATION			V		S
1698	09	RATIO		T	V	M	S
1698	08	SHARP				M	S
1698	07	STARTING			V		S
1698	10	UNSTEADY		T	V	M	S
1698	06	VERTICAL			V	M	S
1698	08	WAKE	N		V		S
1698	09	WING	N	T	V	M	
1699	07	ASPECT			V	M	S
1699	09	CALCULATION	N				
1699	09	CHANGE				M	
1699	09	COEFFICIENT		T	V	M	S
1699	10	DELTA			V		
1699	07	DISTRIBUTION	N			M	S
1699	06	EDGED				M	
1699	10	ELLIPTIC				M	S
1699	09	FINITE		T	V	M	
1699	09	FLOW	N	T	V	M	S
1699	09	FUNCTION	N	T			S
1699	06	GUST	N		V	M	S
1699	10	HARMONICALLY			V	M	S
1699	09	INCOMPRESSIBLE		T	V		S
1699	10	INDICIAL		T	V	M	S
1699	00	LIFT		T		M	S
1699	10	MOTION	N			M	S
1699	05	NORMAL			V	M	
1699	10	OSCILLATING					S
1699	06	PENETRATION			V	M	S
1699	09	PURE				M	S
1699	07	RATIO	N		V	M	S
1699	10	RECTANGULAR			V		S
1699	06	SHARP					
1699	10	SINKING			V	M	S
1699	09	SPAN	N	T	V	M	S
1699	08	SPANWISE			V	M	S
1699	09	SPEED	N		V		
1699	09	SUDDEN			V		
1699	10	TAPERED			V	M	S
1699	10	TRANSITIONAL			V	M	S
1699	10	UNSTEADY			V	M	S
1699	10	WING	N	T			S

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1700 09 CLASSICAL                                 M S
1700 07 COEFFICIENT                       N     V   S
1700 07 CURVE                             N     V M S
1700 07 DETERMINATION                     N         S
1700 07 EDGED                                   V M S
1700 09 EQUATION                                V M S
1700 09 FLOW                              N     V M S
1700 08 FLUTTERING                              V M
1700 09 FORMULA                           N     V M S
1700 07 FORWARD                                 V M S
1700 07 FREQUENCY                               V   S
1700 08 INDICIAL                                V M
1700 10 KIRSCHHOFF                              V M S
1700 10 LIFT                              N T       S
1700 08 LOADING                           N     V   S
1700 08 MOMENT                            N     V M
1700 07 MOTION                            N     V   S
1700 08 OSCILLATING                             V M S
1700 08 PITCHING                          N     V M S
1700 07 RESPONSE                                V M S
1700 08 REVERSED                                V M S
1700 08 ROTATING                                V   S
1700 08 SINKING                           N         S
1700 07 SLOWLY                                  V M S
1700 09 SOLUTION                          N     V M S
1700 06 STARTING                                  M S
1700 09 SUBSONIC                                V M S
1700 09 SUPERSONIC                              V   S
1700 09 THREEDIMENSIONAL                    T   V   S
1700 10 TRANSIENT                               V   S
1700 08 TRIANGULAR                              V   S
1700 09 TWODIMENSIONAL                      T   V M
1700 10 UNSTEADY                            T     M S
1700 10 WAVE                                    V   S
1700 10 WING                              N     V M S
1701 09 AEROFOIL                          N T     M S
1701 08 AILERON                                   M S
1701 07 APPARENT                                  M
1701 10 CIRCULATORY                             V M S
1701 09 COEFFICIENT                       N T       S
1701 07 COMPRESSIBLE                              M
1701 09 DETERMINATION                     N T   V
1701 08 EDGED                                   V M S
1701 07 EFFECT                            N         S
1701 09 FLOW                              N     V
1701 06 FLUTTER                                 V   S
1701 09 FUNCTION                          N     V M
1701 08 GUST                              N     V M S
1701 09 INCOMPRESSIBLE                            M
1701 10 INDICIAL                            T   V M
1701 10 LIFT                              N T   V M S
1701 10 MACH                              N T   V   S
1701 08 MASS                                    V M
1701 10 MOMENT                                  V   S
1701 09 NUMERICAL                           T   V   S
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1701	10	OSCILLATORY		T	V	M	
1701	08	PENETRATION			V		S
1701	08	SHARP			V		S
1701	10	SINKING	N	T	V	M	S
1701	09	SUBSONIC		T	V	M	S
1701	08	TAB			V	M	
1701	09	TWODIMENSIONAL		T	V	M	
1702	09	AEROFOIL	N	T		M	S
1702	09	CALCULATION	N			M	S
1702	00	COEFFICIENT	N		V	M	S
1702	08	EDGED			V	M	
1702	09	FLOW	N		V		
1702	09	FUNCTION	N	T	V	M	S
1702	08	GUST	N				
1702	10	INDICIAL		T			
1702	10	LIFT	N	T	V		S
1702	10	MACH	N	T	V	M	
1702	10	MOMENT		T		M	
1702	09	MOTION	N		V		
1702	10	OSCILLATORY			V		
1702	08	PENETRATING			V	M	S
1702	10	PITCHING		T	V	M	
1702	08	SHARP					S
1702	10	SINKING		T			S
1702	09	SUBSONIC			V	M	S
1702	09	TWODIMENSIONAL		T	V		S
1703	08	ACCELERATION			V	M	S
1703	08	ACOUSTIC				M	S
1703	10	AEROFOIL	N	T	V		S
1703	07	APPROXIMATION	N		V	M	S
1703	07	ASPECT			V	M	S
1703	06	BIRNBAUM			V	M	S
1703	10	COMPRESSIBLE			V		S
1703	08	DISTRIBUTION	N		V	M	S
1703	10	DISTURBANCE	N		V	M	S
1703	08	DOUBLET			V	M	S
1703	08	DOWNWASH			V		S
1703	09	EQUATION	N		V		
1703	08	FIELD	N		V		S
1703	09	FLOW	N		V		S
1703	09	FLUID			V		S
1703	09	GENERALIZED			V	M	
1703	07	HIGH			V		S
1703	08	INFINITE			V	M	S
1703	09	INFINITELY			V	M	S
1703	09	INTEGRAL			V	M	S
1703	08	LORENZ			V	M	S
1703	08	OSCILLATING				M	S
1703	08	PERIODIC			V	M	S
1703	06	POSSION			V	M	S
1703	08	POTENTIAL	N		V	M	S
1703	06	PRANDTL			V	M	S

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1703 08 PRESSURE              V   S
1703 08 RADIATOR          N     M S
1703 07 RATIO             N   V   S
1703 09 SMALL                 V   S
1703 08 SPAN                  V M S
1703 08 SUPERPOSITION         V M S
1703 09 THEORY            N T V M S
1703 08 TRANSFORMATIOM    N   V   S
1703 08 VELOCITY              V M S
1703 08 WING              N   V   S
1704 09 AERODYNAMIC         T V M
1704 08 ALLMOVABLE              M S
1704 08 ANGLE                 V M S
1704 07 ASPECT                V   S
1704 08 ATTACK            N   V   S
1704 09 CALCULATION       N   V M S
1704 08 CANTELEVERED            M S
1704 08 CIRCULAR              V M S
1704 09 COEFFICIENT       N   V M S
1704 10 CONDITION         N   V M SA
1704 08 CONTROL                 M
1704 09 DISTRIBUTION      N   V M S
1704 00 DOWNWASH              V
1704 09 EQUATION          N     M
1704 10 FINITE              T V M
1704 08 FLAPPING              V   S
1704 08 FLOW              N   V M S
1704 08 FLUTTER               V   S
1704 10 FORCE             N T
1704 09 FUNCTION            T V   S
1704 09 INTEGRAL              V M S
1704 10 KERNEL              T V M
1704 10 LIFT              N   V M
1704 10 MOMENT                V M S
1704 09 NUMERICAL
1704 10 OSCILLATING         T V M S
1704 08 OSCILLATION       N   V M S
1704 08 PITCHING              V
1704 08 PLANFORM              V   S
1704 09 PRESSURE              V M S
1704 09 PROCEDURE         N T V M S
1704 07 RATIO             N   V M S
1704 08 RECTANGULAR           V   S
1704 09 SOLUTION          N   V M S
1704 10 STEADY              T     S
1704 09 SUBSONIC            T V M S
1704 08 SURFACE           N
1704 09 SYSTEMATIC          T V   S
1704 08 TAIL              N   V   S
1704 07 UNIFORM                   S
1704 10 WING              N T V M S
1705 09 COMPRESSIBLE          V M S
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1705	09	DISTRIBUTION	N	T	V		
1705	10	DOWNWASH		T	V	M	
1705	09	EQUATION	N	T		M	
1705	09	FINITE		T	V		
1705	09	FLOW	N	T	V	M	
1705	09	FUNCTION	N	T		M	
1705	10	HARMONICALLY			V	M	S
1705	07	INCOMPRESSIBLE				M	
1705	09	INTEGRAL		T	V		
1705	10	KERNEL		T	V		S
1705	10	LIFT		T		M	
1705	09	MOTION			V		S
1705	10	OSCILLATING		T	V	M	S
1705	09	RELATION			V	M	
1705	07	SONIC			V	M	
1705	09	SUBSONIC		T		M	S
1705	10	WING	N	T		M	
1706	09	AEROFOIL	N				S
1706	10	ALTERNATING			V	M	S
1706	08	ANALOGY			V	M	S
1706	08	EDGED			V		S
1706	08	ELECTRICAL			V		
1706	09	FLOW	N	T	V		
1706	10	FOURIER					S
1706	09	FUNCTION	N		V	M	S
1706	08	GUST	N			M	
1706	10	INDICIAL			V	M	S
1706	08	KUSSNER			V		S
1706	10	LIFT	N		V	M	S
1706	09	NONSTATIONARY		T		M	S
1706	08	PENETRATING			V	M	S
1706	09	RECIPROCAL		T	V	M	S
1706	09	RELATION	N	T	V		S
1706	08	SHARP			V		S
1706	10	THEODORSEN			V	M	S
1706	09	THEORY	N	T		M	S
1706	10	TRANSFORMATION	N		V	M	
1706	00	TRANSIENT				M	
1706	10	WAGNER				M	S
1707	10	AERODYNAMIC				M	S
1707	08	ANGLE	N		V		S
1707	07	COEFFICIENT	N				S
1707	08	CONDUCTION	N		V		S
1707	08	CONDUCTIVITY	N		V	M	S
1707	08	CONVECTIVE			V		S
1707	10	COOLING	N			M	
1707	08	DIAMETER	N		V		S
1707	08	DISTRIBUTION	N		V		S
1707	10	EDGE	N			M	S
1707	08	EMISSIVITY	N		V		S
1707	09	FLOW	N		V		S
1707	10	GLIDER			V		S

1707	08	GRAPHITE			V		S
1707	10	HEATING	N		V		S
1707	10	HYPERSONIC		T			
1707	10	LEADING				M	
1707	08	LIFT				M	
1707	10	NOSE	N	T		M	S
1707	10	RADIATION				M	S
1707	10	REGION	N	T	V	M	S
1707	00	SHAPE	N	T		M	S
1707	08	SKIN			V		S
1707	10	STAGNATION		T	V	M	S
1707	08	SWEEP				M	
1707	08	TEMPERATURE			V		S
1707	08	THICKNESS	N		V	M	S
1707	10	VEHICLE	N		V		S
1707	08	WEDGE					S
1708	09	AERODYNAMIC		T		M	S
1708	09	ANGLE			V		S
1708	09	ATTACK	N		V	M	S
1708	09	CHARACTERISTIC	N	T	V		S
1708	09	CONFIGURATION	N		V		S
1708	10	CONTROL	N		V	M	S
1708	08	DEFLECTION	N		V		
1708	08	DIFFERENTIAL			V	M	S
1708	08	DIRECTIONAL			V	M	S
1708	08	DRAG				M	
1708	08	ELEVON			V	M	S
1708	09	FLOW	N		V	M	
1708	10	GLIDER					S
1708	09	HYPERSONIC		T	V		
1708	08	LATERAL					S
1708	10	LIFT	N		V	M	
1708	10	LIFTING				M	S
1708	10	LONGITUDINAL			V	M	S
1708	10	MACH	N				S
1708	08	MOMENT	N		V	M	S
1708	09	PERFORMANCE	N		V		S
1708	08	PITCHING			V	M	S
1708	07	RATIO	N		V	M	S
1708	10	REENTRY		T	V	M	S
1708	08	ROLLING					S
1708	08	RUDDER			V		S
1708	08	SIDESLIP	N		V	M	S
1708	10	STABILITY	N		V		
1708	09	SUPERSONIC		T			S
1708	09	TEST	N		V	M	S
1708	09	TUNNEL			V	M	S
1708	09	WIND			V	M	S
1708	10	WINGED		T			S
1708	08	YAW			V	M	S
1709	09	AERODYNAMIC		T	V	M	
1709	09	ANGLE		T			S

1709	09	ATTACK	N	T	V	M	
1709	08	AXIAL				M	
1709	00	BALANCE			V		S
1709	06	CHAMBER			V	M	S
1709	09	CHARACTERISTIC	N	T	V	M	S
1709	10	CLIPPED			V		
1709	07	COEFFICIENT	N		V	M	
1709	08	DEFLECTION	N		V		S
1709	10	DELTA			V	M	
1709	08	DRAG			V		S
1709	09	FLOW	N		V		S
1709	10	FOLDING		T	V		S
1709	08	FORCE			V	M	S
1709	10	GLIDER		T	V	M	
1709	06	INTERFERENCE	N				S
1709	08	LIFT			V	M	
1709	10	LONGITUDINAL		T			S
1709	07	MAXIMUM			V	M	S
1709	08	MOMENT			V	M	
1709	10	PANEL	N	T	V	M	S
1709	05	PRESSURE				M	S
1709	07	RATIO	N		V	M	S
1709	10	REENTRY		T		M	S
1709	06	REYNOLDS	N				
1709	08	STABILITY	N			M	S
1709	10	STATIC			V	M	S
1709	06	SUPPORT				M	S
1709	10	SWEPTBACK	N		V	M	S
1709	06	SYSTEM			V	M	
1709	09	TEST	N		V	M	S
1709	10	TIP		T	V	M	S
1709	10	TRANSONIC		T		M	S
1709	09	TUNNEL			V		S
1709	09	WIND				M	S
1709	10	WING		T			
1710	07	BODY			V	M	S
1710	10	BOUNDARY		T			S
1710	10	CRITICAL			V	M	S
1710	07	DEGREE			V	M	S
1710	09	DETERMINATION	N		V	M	S
1710	10	DISK	N				S
1710	07	DISTRIBUTION	N			M	
1710	08	ELEMENT	N		V	M	S
1710	07	FLOW	N				S
1710	10	HEIGHT	N	T		M	S
1710	10	LAMINAR					S
1710	10	LAYER	N	T	V	M	S
1710	07	LENGTH			V	M	
1710	08	LOCATION	N		V		S
1710	08	MACH			V	M	S
1710	07	NATURAL					
1710	08	NUMBER	N			M	S
1710	08	PRESSURE					
1710	10	PROMOTION	N			M	S
1710	08	REYNOLDS			V		S
1710	10	ROUGHNESS		T	V		

1710	10	SANDPAPER	N		V		S
1710	08	SHAPE	N		V	M	S
1710	10	SPANWISE				M	S
1710	07	SUBSONIC			V		S
1710	07	SUPERSONIC			V	M	S
1710	10	THREEDIMENSIONAL			V	M	S
1710	10	TRANSITION		T		M	S
1710	09	TUNNEL			V		S
1710	08	TURBULENCE	N				S
1710	10	TWODIMENSIONAL			V	M	S
1710	09	WIND					S
1710	10	WIRE	N		V	M	S
1711	09	AERODYNAMIC		T	V		S
1711	08	ANGLE		T	V	M	S
1711	08	ATTACK	N	T	V	M	
1711	09	CHARACTERISTIC	N	T	V	M	S
1711	09	COEFFICIENT	N		V	M	S
1711	09	CONFIGURATION		T	V		S
1711	08	CONTROL	N		V	M	S
1711	08	DEFLECTION	N				S
1711	10	DELTA		T	V	M	S
1711	08	DRAG			V		S
1711	09	FLOW	N		V	M	S
1711	10	FOLDING		T	V	M	
1711	08	HEATING	N		V	M	S
1711	08	LATERAL			V	M	S
1711	08	LIFT					S
1711	10	LIFTING					
1711	08	LONGITUDINAL					S
1711	08	MOMENT			V		S
1711	10	PANEL	N	T	V	M	
1711	08	PITCHING			V	M	S
1711	08	PLANFORM	N		V		
1711	08	RATIO	N		V		
1711	10	REENTRY		T			S
1711	08	REVERSAL	N		V	M	S
1711	07	SIZE	N		V	M	S
1711	08	STABILITY	N		V		S
1711	09	SUBSONIC		T	V		
1711	10	SWEPTBACK				M	
1711	09	TEST	N		V	M	S
1711	10	TIP		T		M	
1711	09	TUNNEL			V	M	
1711	08	UNFOLDING			V	M	
1711	09	WIND					S
1711	10	WING		T	V	M	
1712	09	AERODYNAMIC		T		M	S
1712	08	ANGLE				M	S
1712	09	ASPECT		T	V	M	S
1712	08	ATTACK	N		V		
1712	09	CHARACTERISTIC	N	T		M	S
1712	09	CONFIGURATION	N		V	M	
1712	09	CONTOUR	N	T		M	S

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1712 07 CURVE                   V M S
1712 08 DRAG                    V   S
1712 10 EDGE                  T V   S
1712 10 ELLIPTIC                  M S
1712 10 FLAT                      M
1712 09 FLOW                N   V   S
1712 08 FUSELAGE                V M
1712 10 GLIDER                      S
1712 09 HIGHLY                  V M S
1712 10 LEADING               T   M
1712 10 LIFT                N   V M S
1712 10 LONGITUDINAL          T   M
1712 09 LOW                   T V
1712 10 PARABOLIC               V   S
1712 10 PLATE                   V   S
1712 09 RATIO               N T V M S
1712 10 RECTANGULAR               M S
1712 10 REENTRY
1712 08 REYNOLDS            N       S
1712 07 SIZE                N     M S
1712 07 SLOPE               N   V   S
1712 10 STABILITY           N   V   S
1712 09 SUBSONIC                  M
1712 10 SWEPT                   V M
1712 10 TRIANGULAR                M S
1712 10 WING                N T V M S
1713 09 ANGLE               N T V M S
1713 09 ATTACK              N T   M
1713 10 BLUNTED               T   M S
1713 08 BOATTAIL                  M S
1713 07 COEFFICIENT         N   V M S
1713 09 CONFIGURATION         T V M S
1713 08 CURVE                   V M
1713 10 DEGREE              N T V M S
1713 10 DIHEDRAL              T V   S
1713 08 DRAG                N   V   S
1713 09 FLOW                    V   S
1713 10 GLIDER                T V M
1713 09 HYPERSONIC              V
1713 08 INCIDENCE           N   V M
1713 08 LIFT                    V M
1713 10 LONGITUDINAL          T V
1713 10 MACH                N T
1713 09 MODEL                     M S
1713 08 MOMENT              N       S
1713 08 NOSE                    V
1713 08 PITCHING                    S
1713 07 RATIO               N   V   S
1713 10 REENTRY               T     S
1713 08 SLOPE               N   V
1713 10 STABILITY           N T V M
1713 10 STATIC                T V M
1713 10 SWEPTBACK               V M S
1713 09 TEST                N     M S
1713 08 TRIM                      M S
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1717	07	AERODYNAMIC			V	M	S
1717	00	AFTERBODY	N		V	M	S
1717	08	ALTITUDE	N			M	
1717	09	ANGLE		T	V	M	S
1717	09	ARBITRARY		T	V	M	S
1717	10	ATMOSPHERE	N	T	V	M	
1717	09	ATTACK	N	T			S
1717	07	BASE	N		V	M	
1717	09	BEHAVIOUR	N		V	M	SA
1717	10	BLUNTED		T	V		S
1717	09	BODY			V		S
1717	09	CALCULATION	N		V	M	S
1717	10	CONE		T	V	M	S
1717	08	CONICAL				M	S
1717	08	CONVECTION			V	M	
1717	10	DEGREE		T			S
1717	09	DYNAMIC				M	S
1717	10	ENTERING		T	V	M	S
1717	08	ENTRY			V		S
1717	09	EQUATION				M	S
1717	07	FLAT			V	M	
1717	07	FORWARD			V	M	S
1717	09	FREEDOM			V	M	S
1717	08	HEATING	N		V		
1717	10	MARTIAN		T	V	M	S
1717	09	MOTION	N	T	V		
1717	08	NOSE			V	M	S
1717	08	OSCILLATORY			V	M	S
1717	10	PITCHING		T		M	S
1717	08	PLANETARY			V	M	
1717	08	POINT			V		S
1717	10	PROBE			V	M	S
1717	09	RATE	N	T	V		
1717	09	RIGID			V	M	S
1717	09	SHORT		T	V		
1717	09	SIX				M	
1717	0	SPIN			V	M	S
1717	08	STABLE			V		
1717	08	STAGNATION			V	M	
1717	08	STATICALLY			V	M	S
1717	08	TRIM			V	M	S
1717	08	TUMBLING				M	S
1717	10	VEHICLE	N		V	M	S
1719	08	ALTITUDE	N		V		S
1719	09	ANALYTICAL			V	M	S
1719	08	ANGLE				M	S
1719	05	APPLIED			V		S
1719	10	ATMOSPHERE	N	T	V		S
1719	08	ATTACK			V	M	S
1719	08	BODY		T	V		S
1719	10	CENTERING					S
1719	07	CESSATION			V	M	S
1719	05	COEFFICIENT	N		V	M	S
1719	06	DAMPING			V	M	S
1719	06	DRAG			V	M	S

1719	09	EQUATION	N		V	M	S	
1719	10	EXPONENTIAL				M		
1719	09	FLAT			V	M	S	
1719	06	FORCE	N				S	
1719	08	LIBRATION			V	M	S	
1719	06	LIFT	N		V	M	S	
1719	09	LINEAR			V	M	S	
1719	06	MOMENT	N		V	M	S	
1719	09	MOTION	N		V			
1719	07	ONSET			V		S	
1719	08	OSCILLATION	N		V		S	
1719	06	PITCH			V			
1719	10	PLANETARY			V	M	S	
1719	00	PLATE	N		V		S	
1719	08	REVOLUTION	N		V		S	
1719	08	SLENDER				M	S	
1719	09	SOLUTION	N		V	M	S	
1719	07	TRANSITION			V	M	S	
1719	10	TUMBLING		T	V	M	S	
1728	06	BOUNDARY			V		S	
1728	05	CONDITION	N		V		S	A
1728	09	CONTINUOUS		T	V	M	S	
1728	08	CURVATURE	N		V	M	S	
1728	05	DEPENDENT			V		S	
1728	09	DETERMINATION	N		V			
1728	08	ENGINE				M	S	
1728	08	FLUCTUATION	N		V	M	S	
1728	09	FREE		T	V	M	S	
1728	10	FREQUENCY	N				S	
1728	10	FUSELAGE					S	
1728	08	MODE			V	M	S	
1728	09	NATURAL			V	M	S	
1728	08	NOISE			V	M		
1728	09	NORMAL			V	M	S	
1728	10	PANEL	N	T		M	S	
1728	07	POWER			V	M	S	
1728	07	PRESSURE			V		S	
1728	08	SHAPE	N				S	
1728	10	SKIN		T	V			
1728	08	SPECTRA	N		V	M	S	
1728	08	STRESS			V	M		
1728	10	STRINGER	N	T	V		S	
1728	07	SUBJECTED			V	M	S	
1728	06	SUPPORTING			V	M	S	
1728	05	TIME			V	M		
1728	00	VIBRATION	N	T	V	M		
1729	06	BEAM	N		V	M		
1729	09	CONTINUOUS		T	V	M	S	
1729	06	DAMPING	N			M	S	
1729	07	DISTRIBUTION	N		V		S	
1729	08	ENGINE			V	M	S	
1729	07	EXPOSED			V	M	S	

1729	08	FREQUENCY				M	S
1729	08	FUSELAGE			V	M	S
1729	08	JET			V	M	S
1729	09	LOADING	N	T	V	M	
1729	10	MODAL			V	M	
1729	08	MODE			V		
1729	08	NOISE	N		V		S
1729	07	NORMAL			V		S
1729	10	PANEL	N	T	V	M	
1729	10	POWELL				M	
1729	09	POWER					S
1729	09	PREDICTION	N		V	M	S
1729	09	PRESSURE			V		S
1729	09	RANDOM		T	V		S
1729	10	RESPONSE	N			M	S
1729	05	SINGLE			V	M	S
1729	10	SKIN		T	V	M	S
1729	05	SPAN				M	
1729	10	SPECTRA	N		V	M	S
1729	09	STATISTICAL			V		S
1729	10	STIFFENER		T	V	M	S
1729	10	STRESS		T	V		S
1729	09	SUPERPOSITION					S
1729	09	THEORY			V	M	S
1729	08	VIBRATION	N			M	S
1748	09	AERODYNAMIC		T	V	M	S
1748	06	BALANCE	N		V		
1748	06	CALCULATION	N		V		S
1748	06	CHORD					S
1748	09	COMPRESSIBLE				M	
1748	10	CONTROL		T		M	S
1748	06	DAMPING			V		
1748	10	DERIVATIVE	N	T	V	M	S
1748	06	DIETZE			V	M	S
1748	09	FLOW	N				S
1748	08	FREQUENCY			V	M	
1748	09	INCOMPRESSIBLE			V		S
1748	06	MACH	N		V		
1748	06	METHOD	N		V	M	S
1748	08	PARAMETER	N		V		S
1748	06	RATIO	N		V		S
1748	10	SURFACE	N	T	V	M	S
1748	08	TAB	N		V		S
1748	10	WING	N	T	V		S
1772	10	AIR			V		S
1772	08	ANGLE	N		V	M	S
1772	08	ATTACK	N		V	M	S
1772	10	AXIAL			V		
1772	10	BLADE	N	T	V	M	S
1772	10	BLOWER			V	M	S
1772	10	BLOWING					S
1772	10	CASCADE					

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1772 09 CHARACTERISTIC                 N     M
1772 07 COEFFICIENT                    N   V M S
1772 10 COMPRESSOR                       T V   S
1772 09 EDGE                           N     M S
1772 10 FLAP                             T V M S
1772 09 FLOW                               V M S
1772 10 JET                            N T V M S
1772 08 LIFT                               V M S
1772 09 NACA                                 M S
1772 07 PRESSURE                           V   S
1772 08 RISE                           N   V M S
1772 08 ROTATING                             M S
1772 09 SECTION                                S
1772 08 STALL                          N   V M S
1772 09 TEST                           N       S
1772 09 THICKENED                              S
1772 09 TRAILING                           V M S
1772 09 TUNNEL                             V M
1772 08 TURNING                            V   S
1779 07 ASPECT                             V M S
1779 07 ASYMPTOTIC                             S
1779 07 BEHAVIOUR                      N   V M SA
1779 09 CALCULATION                    N T V
1779 07 COEFFICIENT                    N   V M
1779 07 COMPRESSIBLE                       V M S
1779 08 DELTA                              V M S
1779 08 ELLIPTICAL                         V   S
1779 07 FLOW                           N   V M S
1779 09 FUNCTION                       N T V M
1779 10 GUST                           N T   M S
1779 07 INCOMPRESSIBLE
1779 08 INDICIAL                           V M S
1779 10 LIFT                             T V M S
1779 07 LOW                                V M
1779 07 MACH                           N   V   S
1779 08 OSCILLATION                    N T V M S
1779 08 OSCILLATORY                        V M S
1779 08 PENETRATION                    N   V M S
1779 07 RATIO                          N   V M S
1779 07 RECIPROCAL
1779 08 RECTANGULAR                        V   SA
1779 07 RELATION                           V M S
1779 08 RESPONSE                       N   V M S
1779 10 RIGID                            T V   S
1779 08 SINKING                          T V M
1779 10 SINUSOIDAL                       T V
1779 07 SONIC                              V M S
1779 07 SUBSONIC                           V M S
1779 07 SUPERSONIC                         V   S
1779 07 TOTAL                                  S
1779 07 TWODIMENSIONAL                     V   S
1779 10 UNSTEADY                         T   M S
1779 07 VANISHING                          V
1779 07 VELOCITY                       N   V M S
1779 07 VERTICAL                           V M
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1779 07 WIDE                                       V M S
1779 10 WING                                   N T V M S
1782 08 ANGLE                                  N       S
1782 08 ASPECT                                     V
1782 09 CALCULATION                            N     M
1782 10 DEGREE                                   T   M
1782 10 DERIVATIVE                             N T V M
1782 08 DIHEDRAL                                       S
1782 06 DISCRETE                                     M S
1782 06 FINITE                                     V   S
1782 08 HORIZONTAL                             N   V M S
1782 06 HORSESHOE                                    M
1782 08 INTERSECTING                               V   S
1782 10 LOAD                                   N T V   S
1782 06 METHOD                                 N   V M S
1782 08 POSITION                                     M S
1782 08 RATIO                                  N   V   S
1782 06 RECTANGULAR                                V M
1782 10 ROLL                                   N T   M S
1782 10 SIDESLIP                               N T V   S
1782 06 SIDEWASH                                   V M
1782 10 SPAN                                     T V M S
1782 10 STABILITY                                T
1782 10 STEADY                                   T
1782 06 STEP                                         M S
1782 10 SUBSONIC                                 T   M S
1782 10 SURFACE                                N T   M S
1782 10 SWEPTBACK                                T V M
1782 06 TABLE                                      V M
1782 10 TAIL                                   N T V   S
1782 10 UNSWEPT                                  T V M S
1782 06 VALUE                                  N   V
1782 08 VERTICAL                                   V M
1782 06 VORTEX                                 N   V   S
1783 06 AERODYNAMIC                                V M S
1783 09 AEROPLANE                              N T V M S
1783 10 ARBITRARY                                T V M S
1783 09 CALCULATION                                  M S
1783 06 COMPRESSIBILITY                            V M S
1783 06 CORRECTION                             N     M S
1783 06 DATA                                   N       S
1783 09 DISTRIBUTION                           N   V   S
1783 08 DIVERGENCE                                 V M S
1783 06 DOWNWASH                                   V M S
1783 08 DYNAMIC                                    V M S
1783 06 EFFECT                                 N     M S
1783 06 ELASTIC                                    V M
1783 06 ELASTICITY                                 V M S
1783 08 EXTERNAL                                   V   S
1783 06 FLEXIBILITY                                V
1783 08 FUSELAGE                               N   V M S
1783 06 HORSESHOE                                  V
1783 06 INTERFERENCE                           N   V M S
1783 06 L-METHOD                                   V   S
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1783	10	LOAD					S
1783	09	MACH			V	M	
1783	08	MATRIX	N		V	M	S
1783	09	METHOD	N	T		M	S
1783	06	MODEL			V		S
1783	10	PLANFORM		T	V		S
1783	08	PRESSURE	N		V	M	S
1783	10	SPAN			V	M	S
1783	10	STATE		T	V	M	S
1783	10	STEADY		T	V		S
1783	10	STIFFNESS		T	V	M	S
1783	08	STORE			V		S
1783	08	STORES	N		V		
1783	06	STRUCTURAL			V	M	
1783	10	SUBSONIC		T		M	S
1783	08	SUBSTANTIAL	N		V	M	
1783	08	SWEPT			V	M	S
1783	08	TAILBOOM				M	S
1783	08	TAILLESS			V	M	S
1783	06	TUNNEL			V		
1783	06	TWIST			V	M	
1783	06	VORTICES	N			M	S
1783	06	WEISSINGER			V	M	S
1783	06	WIND			V		S
1783	10	WING	N	T	V	M	S
1785	08	BOUNDARY			V	M	
1785	09	CALCULATION	N		V		S
1785	06	CIRCULAR			V		S
1785	08	CORNER	N		V	M	S
1785	08	CURVATURE	N		V	M	S
1785	10	CYLINDER	N	T	V	M	S
1785	00	DRAG	N		V	M	S
1785	06	ECCENTRICITY	N				S
1785	08	ELLIPTIC				M	S
1785	08	EQUATION			V		
1785	10	FLOW		T	V	M	S
1785	10	FLUID		T	V		S
1785	08	GENERATORS	N		V	M	S
1785	08	INCOMPRESSIBLE					S
1785	08	LAYER			V	M	S
1785	08	MOTION	N		V		
1785	10	PARALLEL			V		S
1785	08	POHLHAUSEN			V	M	S
1785	08	RADIUS					S
1785	08	SOLUTION	N		V	M	S
1785	08	UNIFORM			V	M	S
1786	08	ANGLE			V		S
1786	06	ARBITRARY			V		S
1786	08	CIRCULAR			V		
1786	08	CORNER	N		V	M	
1786	08	CROSSECTION	N		V		
1786	10	CYLINDER	N	T	V	M	S

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1786 06 DRAG                N   V M S
1786 08 DURATION                V M S
1786 06 EXCESS                  V M
1786 06 FLAT                    V M S
1786 10 FRICTION            N T V M S
1786 10 INFINITE              T V M S
1786 10 LENGTH              N T V M S
1786 08 MOTION              N     M
1786 09 MOVING                T V M S
1786 08 NUMBER                  V M S
1786 10 PARALLEL              T V M S
1786 06 PLATE                     M
1786 08 SHAPE               N   V   S
1786 10 SKIN                  T     S
1786 09 SOLUTION            N       S
1786 08 THREEDIMENSIONAL            S
1786 08 TIME                    V   S
1786 08 UNIDIRECTIONAL          V M S
1786 08 VISCOUS                 V
1786 08 WIDTH               N     M S
1787 10 ARBITRARY             T V M S
1787 08 ASYMPTOTIC              V M S
1787 06 BOUNDARY                V   S
1787 06 CIRCULAR                V   S
1787 04 CONDUCTION          N   V M S
1787 06 CROSS                     M
1787 10 CYLINDER            N T V M S
1787 06 DISTRIBUTION        N   V M S
1787 06 DRAG                    V   S
1787 06 ELLIPTIC                V M S
1787 08 EXPANSION               V   S
1787 10 FLUID               N   V M S
1787 08 FORMULA             N   V   S
1787 06 FRICTION            N   V M S
1787 06 FRICTIONAL              V M
1787 04 HEAT                    V M S
1787 09 INCOMPRESSIBLE          V M S
1787 06 JOUKOWSKI               V M S
1787 06 LAYER                   V M S
1787 08 LENGTH              N   V M S
1787 09 MOTION                  V M S
1787 08 MOVING                      S
1787 08 PARALLEL                V   S
1787 10 PROBLEM             N T   M S
1787 06 PROFILE                   M S
1787 10 RAYLEIGH              T V M
1787 06 SECTION                 V M
1787 10 SHAPE               N T V   S
1787 06 SKIN                    V   S
1787 09 SOLUTION            N   V M S
1787 06 THEORY              N   V   S
1787 08 UNIFORM
1787 08 VELOCITY                V M S
1787 09 VISCOUS                 V M S
1787 06 VORTICITY                 M S
1788 06 ANGLE                     M S
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1788	09	APPROXIMATE		T			
1788	10	ARBITRARY		T	V		S
1788	10	AREA	N			M	S
1788	09	BOUNDARY		T	V		
1788	06	CONCAVE			V	M	
1788	06	CONVEX			V	M	S
1788	06	CORNER	N		V	M	S
1788	10	CROSS		T	V	M	S
1788	10	CYLINDER	N	T	V	M	S
1788	10	DISPLACEMENT					
1788	08	DISTANCE			V	M	S
1788	09	DISTRIBUTION	N		V		S
1788	08	EDGE	N		V	M	S
1788	06	ELLIPTIC			V		S
1788	06	FINITE			V	M	S
1788	06	FLAT				M	
1788	08	FORCE	N		V		S
1788	10	FRICTION	N		V	M	
1788	09	GENERATORS	N		V	M	S
1788	06	IN	N				
1788	09	LAYER	N	T	V		S
1788	08	LEADING			V	M	S
1788	00	LOCALLY			V	M	S
1788	06	LONG			V		
1788	07	METHOD	N		V	M	S
1788	09	PARALLEL			V		S
1788	06	PLATE	N		V		S
1788	08	POHLHAUSEN			V	M	S
1788	06	POLYGON			V		S
1788	07	PROFILE	N		V		S
1788	06	REENTRANT			V		S
1788	08	RETARDING			V	M	S
1788	10	SECTION	N	T		M	S
1788	10	SEMIINFINITE		T		M	S
1788	10	SKIN					S
1788	09	STREAM			V	M	S
1788	09	THEORY	N	T	V	M	S
1788	08	THICKNESS	N		V	M	S
1788	07	VELOCITY			V	M	S
1788	08	VISCOUS			V	M	
1792	06	ABOUT			V		S
1792	06	ADVERSE			V	M	S
1792	09	AERODYNAMIC			V	M	S
1792	09	AIRCRAFT	N	T	V	M	S
1792	06	AIRSPEED			V		S
1792	06	ANGLE			V		
1792	08	ARRANGEMENTS	N		V	M	S
1792	06	ATTACHED			V	M	S
1792	06	AVRO	N		V	M	S
1792	06	BLOWING			V	M	S
1792	06	BLOWN			V		S
1792	08	BODY			V	M	S
1792	08	BOUNDARY			V		
1792	06	BUFFETING	N		V		S
1792	00	CENTRE	N		V		S
1792	06	CHORD			V	M	S
1792	08	CONTROL	N		V		S
1792	06	DAMPING	N		V		S

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1792 06 DEGREE                    N   V   S
1792 06 DERIVATIVE                N   V M S
1792 06 DIRECTIONAL                   V M S
1792 06 EDGE                      N   V   S
1792 06 EFFECT                    N   V M S
1792 06 FLAP                      N   V   S
1792 06 FLIGHT                        V M S
1792 08 FLOW                      N   V M S
1792 06 FULLY                         V M S
1792 06 GLIDE                         V M S
1792 06 GROUND                        V   S
1792 06 HANDLING                      V M S
1792 09 HIGH                        T V M
1792 06 HOLDING                   N   V M S
1792 06 KNEE                      N   V M S
1792 06 LATERAL                       V M S
1792 08 LAYER                         V M S
1792 06 LEADING                       V   S
1792 06 LIFT                      N   V M S
1792 06 LONGITUDINAL                  V M S
1792 10 LOW                         T V M S
1792 06 MACH                      N   V M S
1792 06 MANOEUVRE                     V M S
1792 06 MARGIN                    N   V M S
1792 06 MAXIMUM                       V M S
1792 06 MODEL                     N   V M S
1792 06 MOMENT                        V M S
1792 06 NEARTRIANGULAR                V M S
1792 06 PATH                          V M S
1792 06 PHUGOID                       V   S
1792 06 PILOTING                  N   V   S
1792 06 PITCH                     N   V   S
1792 06 PITCHUP                   N   V M S
1792 06 PLANE                         V M S
1792 08 PLANFORM                  N   V M
1792 09 PROBLEM                     T V M S
1792 06 PROXIMITY                     V   S
1792 06 QUALITY                   N   V M S
1792 06 RAE                           V   S
1792 06 RATIO                         V M S
1792 06 ROLLING                       V   S
1792 06 ROTARY                        V   S
1792 06 SECTION                   N   V M S
1792 08 SEPARATION                N   V   S
1792 08 SHAPE                         V   S
1792 06 SHARP                         V
1792 06 SIDESLIP                  N   V M S
1792 08 SLENDER                       V M S
1792 09 SPEED                     N T V   S
1792 08 STABILITY                 N   V   S
1792 06 STATIC                        V   S
1792 00 STREAMWISE                    V M S
1792 06 SUCTION                       V M S
1792 09 SUPERSONIC                    V M S
1792 08 SWEPT                         V M S
1792 08 SWEPTBACK                       M S
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1792 06 TEST                         N   V   S
1792 06 THICKNESS                        V   S
1792 06 TRAILING                         V M S
1792 06 TUNNEL                           V M S
1792 06 VERTICAL                         V M S
1792 06 WIND                             V   S
1792 08 WING                         N   V M S
1792 06 YAWING                           V   S
1793 09 ASPECT                           V   S
1793 07 BOUNDARY                         V M S
1793 08 BOW                              V M S
1793 10 DEGREE                       N     M
1793 08 DETACHED                         V
1793 10 EDGE                             V M S
1793 09 FLOW                         N T V M S
1793 07 FORMATION                    N   V   S
1793 09 HALF                               M S
1793 10 INCIDENCE                    N   V M S
1793 07 INDUCED                          V M S
1793 07 LAYER                            V   S
1793 10 LEADING                          V M S
1793 08 MODEL                            V M S
1793 07 MOVEMENT                     N   V M S
1793 09 OIL                              V M S
1793 09 PATTERN                      N T V M
1793 09 RATIO                            V M S
1793 08 SEPARATION                   N     M S
1793 07 SHAPE                        N   V   S
1793 08 SHOCK                            V
1793 09 STUDY                        N   V M S
1793 09 SUBSONIC                           M S
1793 09 SUPERSONIC                       V M S
1793 09 SURFACE                          V M S
1793 10 SWEEP                            V   S
1793 10 SWEPTBACK                      T   M S
1793 10 TAPER                              M
1793 10 TAPERED                        T V M S
1793 07 TEST                         N   V M S
1793 08 TRANSITION                   N       S
1793 09 TRANSONIC                        V   S
1793 07 TUNNEL                           V M S
1793 08 VORTEX                               S
1793 08 WAVE                         N   V   S
1793 07 WIND                             V M S
1793 09 WING                           T V   S
1794 09 ASPECT                           V M S
1794 08 BENDING                          V M
1794 07 BOUNDARY                         V   S
1794 07 CENTRE                           V   S
1794 09 CHORD                            V M S
1794 08 CHORDWISE                        V M S
1794 07 COEFFICIENT                  N   V M S
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1794 10 DEGREE                               V M
1794 09 DEVELOPMENT                      N   V M S
1794 09 DISTRIBUTION                     N   V M S
1794 08 DRAG                             N   V M S
1794 09 EDGE                             N   V   S
1794 09 FLOW                             N   V   S
1794 09 FORCE                                V M S
1794 07 FORWARD                              V   S
1794 07 GROWTH                           N   V M S
1794 09 HALF                                 V   S
1794 09 INCIDENCE                        N   V   S
1794 07 INDUCED                              V   S
1794 07 INITIAL                                M S
1794 07 INTERACTION                      N   V M S
1794 07 LAYER                                V M S
1794 09 LEADING                              V   S
1794 08 LIFT                             N   V M S
1794 08 LOADING                          N   V M S
1794 09 MEASUREMENT                      N   V M
1794 08 MOMENT                           N   V M
1794 07 NORMAL                               V   S
1794 07 OIL                                  V   S
1794 07 OUTBOARD                             V M S
1794 07 PATTERN                          N   V   S
1794 08 PITCHING                             V M S
1794 09 PLANFORM                           T V   S
1794 09 PLOTTING                         N   V M S
1794 09 PRESSURE                         N   V   S
1794 08 SEPARATION                       N   V M S
1794 08 SHOCK                                    S
1794 07 SPAN                                 V M S
1794 08 SPANWISE                                 S
1794 09 SUBSONIC                             V M S
1794 09 SUPERSONIC                           V M S
1794 09 SURFACE                              V M S
1794 10 SWEPTBACK                          T V   S
1794 09 TAPER                                V M S
1794 09 TEST                             N   V M S
1794 09 THICKNESS                            V M S
1794 07 TIP                                  V M S
1794 08 TRANSITION                       N   V   S
1794 09 TRANSONIC                            V M S
1794 09 TUNNEL                               V M S
1794 08 VORTEX                               V   S
1794 10 WARREN12                           T V   S
1794 08 WAVE                             N   V M S
1794 09 WIND                                 V M S
1794 09 WING                               T V M S
1795 06 BLOCKAGE                             V M S
1795 06 BLOWING                              V M
1795 06 FLOW                                 V M S
1795 06 HALF                                 V M S
1795 08 INTERFERENCE                     N   V   S
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1795 06 LIFT                        V   S
1795 08 LINERS                  N   V M S
1795 06 MACH                    N   V M
1795 06 MODEL                   N   V M
1795 06 MODIFIED                      M S
1795 10 NPL                       T V   S
1795 06 POWER                         M S
1795 06 PRESSURE                N   V M S
1795 09 RANGE                   N T V M S
1795 06 REQUIREMENT             N   V M S
1795 08 SLOTTED                     V M
1795 06 SPAN                        V   S
1795 09 SPEED                     T V M
1795 06 SURVEY                  N   V M S
1795 06 SWEPT                           S
1795 06 TEST                    N   V   S
1795 10 TRANSONIC                 T V   S
1795 10 TUNNEL                  N T V   S
1795 08 WALL                        V   S
1795 10 WIND                      T
1795 06 WING                    N   V   S
1796 06 BALLOTINI                   V M S
1796 10 BAND                    N T     S
1796 06 BEAD                        V M S
1796 08 BETWEEN                       M S
1796 09 BOUNDARY                  T
1796 10 CARBORUNDUM             N   V M S
1796 10 CROPPED                   T V
1796 10 DELTA                     T V M
1796 10 DISTRIBUTED               T V M
1796 08 DRAG                        V   S
1796 10 EDGE                    N T     S
1796 06 GLASS                       V
1796 08 GRAIN                   N   V   S
1796 10 HALF                      T V M S
1796 06 HEXACHLORETHANE         N   V M S
1796 08 INCIDENCE               N   V
1796 06 INDICATOR               N     M S
1796 09 LAYER                     T V   S
1796 10 LEADING                   T
1796 08 LIFT                    N   V M S
1796 08 MACH                    N   V   S
1796 08 MATERIAL                N   V   S
1796 08 MOMENT                  N       S
1796 10 NEAR                        V M
1796 08 PARTICLE                      M
1796 08 PENALTY                 N   V M S
1796 08 PITCHING                        S
1796 10 ROUGHNESS                 T     S
1796 08 SIZE                    N   V M
1796 08 SPACING                     V M
1796 09 SPEED                   N T V M  A
1796 06 SUBLIMATION                 V
1796 07 TECHNIQUE               N   V M S
1796 07 TEST                    N
1796 10 TRANSITION              N T V M S
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1796 09 TRANSONIC                         T V M S
1796 07 TUNNEL                                M S
1796 08 WAVE                                V   S
1796 08 WIDTH                           N   V   S
1796 07 WIND                                V M S
1796 10 WING                            N T V M S
1797 06 AEROFOIL                        N   V
1797 06 APPEARANCE                      N   V M S
1797 08 ATTACHMENT                      N   V   S
1797 08 BLUNT                               V   S
1797 08 BOUNDARY                              M S
1797 08 COEFFICIENT                     N   V M S
1797 08 COMPONENT                       N   V M
1797 10 DEGREE                            T V M S
1797 08 DEPENDENT                           V   S
1797 06 DESIGN                          N     M S
1797 08 DRAG                                V
1797 08 DROOP                           N   V M S
1797 10 EDGE                            N T V M S
1797 06 ESTIMATION                      N   V   S
1797 09 FLOW                              T V M
1797 08 FORWARD                             V   S
1797 08 HALF                                V M S
1797 06 INBOARD                             V   S
1797 08 INDUCED                             V M S
1797 06 INITIAL                             V M S
1797 08 LAYER                               V   S
1797 10 LEADING                           T V
1797 08 LIFT                                V   S
1797 06 LOCAL                               V M S
1797 10 MACH                            N   V   S
1797 08 MODEL                           N       S
1797 08 NOSED                               V M S
1797 08 OILFLOW                               M S
1797 06 OUTBOARD                            V M S
1797 10 PATTERN                         N     M
1797 10 PROFILE                         N   V M S
1797 08 RADIUS                          N   V M S
1797 06 REAR                                  M S
1797 08 SEPARATION                      N       S
1797 08 SHARP                               V   S
1797 08 SHOCK                                 M S
1797 09 SPEED                           N T V   SA
1797 06 SURFACE                         N   V M S
1797 10 SWEPTBACK                         T V M S
1797 06 SWEPTFORWARD                        V M S
1797 09 TEST                            N   V   S
1797 06 THREEDIMENSIONAL                    V M S
1797 06 TIME                                V   S
1797 06 TIP                                 V M
1797 10 TRANSONIC                         T V M S
1797 09 TUNNEL                                M S
1797 06 TWODIMENSIONAL                      V M S
1797 10 UNTAPERED                           V M S
1797 06 UPPER                               V   S
1797 06 VORTEX                          N   V M
1797 08 WAVE                            N   V   S
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1797 09 WIND                                    V   S
1797 09 WING                                N T V M S
1798 08 AERODYNAMIC                               M S
1798 07 AEROFOIL                            N   V   S
1798 09 BOUNDARY                              T V M S
1798 06 BUFFETING                           N   V M
1798 00 BUZZ                                N   V   S
1798 07 CHARACTERISTIC                      N   V M
1798 07 COEFFICIENT                         N   V M S
1798 06 COMPRESSION                             V M
1798 06 CONTROL                                 V M S
1798 05 DISTRIBUTION                        N   V   S
1798 08 EDGE                                N   V M S
1798 05 EFFECT                              N T V M S
1798 08 ENGINE                                  V M S
1798 06 EXPANSION                               V M S
1798 07 FLAT                                    V M S
1798 07 FLOW                                N   V   S
1798 07 FORCE                                   V   S
1798 07 GENERATED                               V M S
1798 07 HIGH                                    V M S
1798 06 INCIDENT                                V M S
1798 07 INDUCED                                 V M S
1798 05 INFLUENCE                           N   V
1798 08 INTAKE                              N T V   S
1798 10 INTERACTION                         N T V M S
1798 09 LAMINAR                                 V   S
1798 09 LAYER                               N T V M S
1798 09 MACH                                N   V   S
1798 00 MOMENT                                  V M S
1798 07 MOTION                                  V M S
1798 08 OBLIQUE                                     S
1798 07 PERFORMANCE                         N T V   S
1798 07 PLATE                               N   V M S
1798 05 PREDICTION                          N   V   S
1798 07 PRESSURE                                V   S
1798 08 REATTACHMENT                        N   V M S
1798 07 RECOVERY                                  M S
1798 07 REDUCTION                           N   V M S
1798 06 REFLECTED                               V M
1798 09 REYNOLDS                            N   V   S
1798 36 SCALE                                   V   S
1798 05 SECTION                                 V   S
1798 08 SEPARATION                          N   V
1798 05 SHAPE                               N   V
1798 10 SHOCK                                 T V M S
1798 05 STATIC                                  V M S
1798 07 STEADY                                  V   S
1798 09 STRENGTH                            N   V M
1798 07 SUBSONIC                                V M S
1798 00 SUPERSONIC                            T V   S
1798 06 SURFACE                                 V M S
1798 05 TEST                                N   V   S
1798 08 TRAILING                                V M S
1798 07 TRANSONIC                               V   S
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1798	05	TUNNEL			V		S	
1798	09	TURBULENT			V	M	S	
1798	07	TWODIMENSIONAL			V	M	S	
1798	06	UPSTREAM			V		S	
1798	10	WAVE	N	T	V		S	
1798	07	WEDGE			V	M		
1798	06	WIND			V		S	
1798	07	WING	N		V	M	S	
1799	10	AEROFOIL	N	T	V	M	S	
1799	08	AREA			V	M	S	
1799	08	BLOCKAGE			V		S	
1799	08	BOUNDARY			V	M	S	
1799	08	CHOKING			V		S	
1799	08	CHORD			V		S	
1799	08	CONFIGURATION	N		V		S	
1799	06	CORRECTION	N		V	M	S	
1799	06	DISTORTION			V		S	
1799	10	EFFECT	N	T	V		S	
1799	08	FLOW	N		V	M		
1799	08	HEIGHT	N		V		S	
1799	10	HIGH		T	V	M	S	
1799	08	INCIDENCE	N		V		S	
1799	10	INTERFERENCE		T	V	M	S	
1799	08	LAYER			V		S	
1799	08	LIFT	N			M	S	
1799	06	LOCAL			V		S	
1799	08	MACH	N		V	M		
1799	10	MODEL			V	M	S	
1799	08	OPEN			V	M		
1799	06	PREDICTION	N		V	M	S	
1799	08	RATIO				M	S	
1799	08	REDUCTION				M		
1799	08	SECTION	N					
1799	08	SEPARATED				M	S	
1799	08	SEPARATION	N		V	M		
1799	06	SEVERELY			V	M		
1799	08	SIMULATION	N			M	S	
1799	08	SIZE	N		V	M	S	
1799	08	SLOT			V	M	S	
1799	08	SLOTTED			V	M		
1799	09	SPEED	N	T	V			A
1799	10	SUBSONIC		T		M	S	
1799	06	SUPERSONIC			V	M	S	
1799	09	TEST	N	T	V			
1799	06	THEORETICAL				M	S	
1799	10	TRANSONIC		T		M	S	
1799	10	TUNNEL		T	V		S	
1799	10	TWODIMENSIONAL		T			S	
1799	08	WAKE			V	M	S	
1799	08	WALL	N		V	M	S	
1799	10	WIND		T	V	M	S	
1799	08	WORKING			V		S	
1799	06	ZERO			V			

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1800 08 BLOCKAGE                                 V M
1800 10 CYLINDER                               T V   S
1800 08 DISTRIBUTION                         N   V M
1800 06 DRAG                                 N       S
1800 08 FIELD                                    V
1800 10 HEMISPHERICAL                              M S
1800 06 INCIDENCE                            N
1800 10 INTERFERENCE                         N T     S
1800 10 LONG                                       M S
1800 10 MACH                                 N   V M S
1800 08 MODEL                                N T V M S
1800 08 MOVEMENT                                 V   S
1800 10 NOSE                                 N   V   S
1800 08 PLOTTING                                     S
1800 08 POINT                                    V M S
1800 08 POSITION                             N   V   S
1800 08 PRESSURE                                 V M S
1800 08 RATE                                     V M S
1800 08 RATIO                                N   V M S
1800 08 REFLECTION                                   S
1800 06 SECTION                                    M S
1800 08 SHOCK                                    V M S
1800 06 SIZE                                 N   V M S
1800 10 SLOTTED                                  V   S
1800 08 SONIC                                    V M S
1800 09 SPEED                                N T V M S
1800 08 SURFACE                                  V M S
1800 08 TERMINAL                                 V M S
1800 10 TEST                                 N   V M
1800 10 TRANSONIC                              T   M S
1800 00 TUNNEL                                   V
1800 10 WALL                                 N T V M S
1800 08 WAVE                                 N   V   S
1800 10 WIND                                       M S
1800 06 WORKING                                    M S
1800 06 ZERO                                     V   S
1836 06 AIRCRAFT
1836 05 ALLOY                                N   V   S
1836 06 ALUMINIUM                                V M S
1836 09 ANALYSIS                             N   V M
1836 08 APPROXIMATE                                M
1836 06 AXIAL                                    V M S
1836 08 BENDING                                  V M S
1836 10 BUCKLING                             N       S
1836 07 COEFFICIENT                                M S
1836 10 COMPRESSION                          N   V M S
1836 06 COMPUTER                             N   V   S
1836 06 CONCENTRIC                                 M S
1836 08 CONTROL                                  V   S
1836 08 COUPON
1836 07 DEPENDENT                                  M S
1836 10 DISTRIBUTION                         N T V M S
1836 10 ELASTIC                                  V   S
1836 08 ELASTICITY                           N   V M S
1836 10 ELEVATED                                 V   S
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1836	08	EXPANSION	N			M	
1836	09	EXPERIMENTAL		T	V	M	S
1836	10	FLAT			V		S
1836	09	GRADIENT	N	T			S
1836	06	INSTRUMENTATION	N		V	M	S
1836	09	INVESTIGATION	N	T			
1836	08	LINEAR					
1836	10	LOAD	N	T	V	M	S
1836	10	LONG		T			S
1836	10	LONGITUDINAL		T	V		S
1836	08	MATERIAL			V	M	S
1836	08	MODULUS					S
1836	10	ONEDIMENSIONAL	N		V		S
1836	10	PLASTIC					S
1836	10	PLATES		T		M	S
1836	08	POSTBUCKLING	N				S
1836	09	RANGE	N			M	
1836	08	ROOM			V		S
1836	10	SIMPLY			V	M	S
1836	07	SOLUTION	N		V	M	S
1836	10	STRESS	N	T	V		S
1836	06	STRUCTURE	N		V		S
1836	10	SUPPORTED	N		V		S
1836	10	TEMPERATURE	N	T		M	
1836	08	TENSION			V		S
1836	10	TEST	N		V	M	S
1836	10	THERMAL			V	M	S
1836	09	TRANSVERSE		T	V	M	S
1836	08	UNIFORM	N		V	M	
1836	07	VALUE	N		V	M	
1874	08	AIR	N		V	M	S
1874	08	COMPRESSED			V	M	S
1874	09	CRITICAL		T	V		
1874	08	ELASTICITY	N		V	M	S
1874	10	FLUTTER		T	V		
1874	08	GRAVITY	N				S
1874	07	INCREASED			V		S
1874	08	LOADING	N		V		S
1874	08	MASS			V		S
1874	10	MODEL		T	V	M	S
1874	09	PREDICTION	N		V		S
1874	07	REDUCTION			V		
1874	09	SPEED	N	T		M	S
1874	09	TEST	N		V	M	
1874	09	TUNNEL	N		V	M	S
1874	09	WIND			V	M	S
1879	08	BOUNDARY	N		V	M	S
1879	08	CONSTRUCTION	N		V	M	S
1879	08	DENSITY				M	S
1879	10	FLUTTER		T	V		
1879	10	MODEL	N	T	V		S
1879	07	RATIO	N		V		

1879	09	SPEED	N	T	V			
1879	08	STIFFNESS			V		S	
1879	07	TEST	N		V	M	S	
1879	09	TESTING	N	T		M	S	
1879	10	TRANSONIC		T		M	S	
1879	09	TUNNEL			V	M	S	
1879	06	VIBRATION			V			
1879	08	WEIGHT			V		S	
1879	09	WIND			V	M		
1880	06	BENDING				M	S	
1880	09	DESIGN	N	T	V		S	
1880	07	FLOW			V	M		
1880	10	FLUTTER		T	V	M	S	
1880	10	MODEL	N	T	V		S	
1880	07	PARAMETER	N		V			A
1880	07	PRECIPITATION	N		V	M	S	
1880	06	RIGIDITY	N		V	M	S	
1880	05	STATIC				M	S	
1880	06	STIFFNESS	N		V	M	S	
1880	09	SUPERSONIC		T	V		S	
1880	08	TEST	N		V		S	
1880	05	TESTING	N	T	V	M	S	
1880	06	TORSIONAL			V	M	S	
1880	06	TORSO			V			
1880	09	TUNNEL			V		S	
1880	07	VARIATION			V	M		
1880	06	VIBRATION			V			
1880	09	WIND			V	M	S	
1916	09	ASPECT		T	V	M	S	
1916	08	ASYMMETRIC			V	M	S	
1916	08	BENDING			V	M	S	
1916	09	BLOW			V		S	
1916	08	DAMPING			V	M	S	
1916	10	DELTA				M		
1916	08	DERIVATIVE	N		V	M	S	
1916	09	DIFFERENTIAL			V	M	S	
1916	08	DYNAMIC			V	M	S	
1916	05	EFFECT	N					
1916	08	ELASTIC			V	M	S	
1916	09	EQUATION	N		V		S	
1916	09	FLOW	N	T	V		S	
1916	09	FOURIER			V	M	S	
1916	10	FREQUENCY	N		V	M		
1916	09	ITERATIVE			V		S	
1916	09	LINEAR			V		S	
1916	08	MODE	N		V			
1916	10	NONSTEADY			V	M	S	
1916	10	OSCILLATING		T	V	M	S	
1916	08	OSCILLATION	N		V	M	S	
1916	09	PARTIAL			V	M	S	
1916	09	PERTURBATION				M	S	

1916	08	PITCH	N		V		S
1916	08	PITCHING			V	M	S
1916	08	PLUNGING				M	S
1916	09	POTENTIAL	N		V	M	S
1916	09	RATIO	N	T	V	M	
1916	09	REDUCED			V	M	S
1916	09	REDUCTION			V		S
1916	08	RIGID			V	M	S
1916	08	ROLLING			V	M	S
1916	09	SOLUTION	N		V	M	S
1916	00	STABILITY					S
1916	06	THICKNESS				M	S
1916	09	THREEDIMENSIONAL			V		S
1916	08	TORSIONAL			V		S
1916	09	TRANSFORMATION	N		V		S
1916	10	TRANSONIC		T	V	M	S
1916	10	WING	N	T	V	M	
1919	09	AERODYNAMIC			V	M	S
1919	09	ASPECT		T	V	M	
1919	09	ASYMPTOTIC					S
1919	09	BLOW			V	M	S
1919	09	CALCULATION	N		V	M	
1919	08	CHORDWISE			V	M	S
1919	07	COEFFICIENT	N		V	M	S
1919	08	DAMPING					S
1919	08	DISTRIBUTION	N		V	M	S
1919	09	EXPANSION			V	M	S
1919	09	FLOW	N	T	V	M	S
1919	10	FORCE	N		V		
1919	08	LIFT			V		
1919	08	MOMENT			V	M	
1919	10	OSCILLATING		T	V		S
1919	08	PITCH	N		V	M	
1919	08	PITCHING					S
1919	09	POTENTIAL			V		S
1919	08	PRESSURE			V		
1919	09	RATIO	N	T	V	M	S
1919	10	RECTANGULAR		T	V	M	S
1919	09	SERIES	N			M	S
1919	08	SLENDER			V	M	S
1919	08	SPANWISE					S
1919	07	THEORY	N		V	M	S
1919	07	TOTAL			V	M	S
1919	08	TRANSLATION	N		V		S
1919	10	TRANSONIC		T	V	M	S
1919	10	UNSTEADY		T	V		S
1919	09	VELOCITY				M	
1919	10	WING	N	T	V	M	S
1920	09	APPROXIMATION	N		V		S
1920	09	ASPECT		T	V	M	S
1920	09	ASYMPTOTIC			V		
1920	09	DISTRIBUTION	N		V	M	S
1920	09	FLOW	N	T		M	

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1920 10 INCLINED
1920 10 LAMINAR                       T V M S
1920 10 LIFT                            V M S
1920 09 LINEARIZED                      V M
1920 09 LONG                            V M
1920 09 NARROW                            M S
1920 09 POTENTIAL                       V   S
1920 09 RATIO                             M
1920 09 SOLUTION                    N T V M S
1920 09 SUPERSONIC                  N       S
1920 09 THEORY                        T V   S
1920 10 WING                            V M
1920 09 ZERO                        N T V M S
1921 10 BODY                          T V
1921 07 CALCULATION                 N T V M S
1921 08 CHORDWISE                   N   V   S
1921 08 DELTA                           V   S
1921 07 DESIGN                          V M S
1921 07 DETERMINATION               N   V   S
1921 08 DISTRIBUTION                N   V   S
1921 07 DRAG                        N   V M S
1921 06 EXPANSION                   N   V   S
1921 07 EXTENSION                       V M S
1921 08 FLAT                        N T   M S
1921 07 FLOW                            V M
1921 08 FORCE                       N   V M S
1921 08 INCIDENCE                       V   S
1921 08 LIFT                        N   V
1921 05 LINEARIZED                      V M S
1921 05 METHOD                          V M S
1921 07 MINIMUM                     N   V M S
1921 08 NOTSOSLENDER                    V   S
1921 08 PLATE                           V M S
1921 08 POINTED                         V   S
1921 06 POTENTIAL                       V   S
1921 08 PRESSURE                        V M S
1921 06 SINK                            V   S
1921 10 SLENDER                         V M S
1921 08 SLOPE                         T V M S
1921 06 SOURCE                      N     M S
1921 07 SUBSONIC                            S
1921 07 SUPERSONIC                      V M
1921 10 THEORY                            M S
1921 08 THREEDIMENSIONAL            N T V M S
1921 08 UNSTEADY                        V   S
1921 06 VELOCITY                        V M S
1921 06 VONKARMAN                       V M S
1921 08 WARD                            V M
1921 10 WING                            V M S
1963 06 BETWEEN                     N   V M S
1963 08 BIOT                              M S
1963 08 CHANNEL                     N     M S
                                        V M S
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1963	10	CONVECTION		T	V	M	S
1963	08	DISTRIBUTION					S
1963	10	EQUATION	N		V		
1963	06	EXPANSION			V	M	S
1963	08	FLOW	N		V		S
1963	08	FLUID				M	
1963	00	FORCED			V		S
1963	06	FUNCTION			V	M	S
1963	10	HEAT	N	T	V	M	
1963	06	LARGE			V	M	S
1963	06	METHOD	N		V	M	S
1963	06	NUMBER	N			M	
1963	06	ORTHOGONAL			V	M	S
1963	08	PARABOLIC			V		S
1963	08	PARALLEL			V		S
1963	06	PECLET			V		S
1963	08	PLATE	N		V	M	S
1963	10	PRINCIPLE	N	T	V	M	S
1963	08	SEMIINFINITE				M	S
1963	08	SLUG				M	S
1963	08	STEADY			V		S
1963	08	TEMPERATURE			V		S
1963	10	TRANSFER	N		V	M	S
1963	08	TRANSIENT			V	M	S
1963	08	TWO			V	M	S
1963	10	VARIATION			V	M	S
1963	10	VARIATIONAL		T	V	M	S
1964	08	BOUNDARY			V	M	S
1964	10	COEFFICIENT	N	T			S
1964	06	CONTRACTING			V	M	S
1964	06	CONTRACTION			V		S
1964	08	CONVERGING			V	M	S
1964	06	DATA	N		V		S
1964	06	DESIGN	N		V	M	S
1964	06	DIAMETER			V		
1964	10	DISCHARGE		T		M	
1964	10	ENTRANCE		T	V	M	S
1964	10	ENTRY			V		S
1964	06	EQUIVALENT			V	M	S
1964	06	EXPERIMENTAL			V	M	
1964	08	FLOW	N		V	M	S
1964	10	FLOWMETER	N	T		M	S
1964	06	FRICTIONAL			V		S
1964	08	LAYER			V		S
1964	06	LENGTH			V	M	S
1964	08	NOZZLE	N		V	M	S
1964	05	NUMBER	N		V		S
1964	08	POTENTIAL					
1964	06	PRESSURE			V	M	S
1964	06	RATIO			V	M	
1964	06	REYNOLDS			V	M	S
1964	10	ROUNDED			V	M	S
1964	06	SECTION	N			M	S
1964	06	SHAPE	N		V	M	S
1964	06	TAP	N		V	M	S
1964	09	THEORY	N	T			S

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1964 06 TOTAL                     V
1964 10 VENTURIS              N T       S
1965 09 ANALYTIC                T     M S
1965 06 APPROXIMATE               V
1965 08 BOUNDARY                  V M S
1965 10 COEFFICIENT           N T V     S
1965 06 DATA                  N   V     S
1965 09 DETERMINATION         N T V M S
1965 08 DIAMETER              N   V M S
1965 10 DISCHARGE               T V
1965 08 EFFECT                N   V M S
1965 06 EQUATION              N   V     S
1965 00 EXPERIMENTAL              V M S
1965 09 FLOW                    T V     S
1965 09 FLUID                     V     S
1965 08 FRICTION                  V M
1965 08 FUNCTION              N   V     S
1965 08 GEOMETRY              N   V M S
1965 06 INTEGRATION           N   V M S
1965 08 LAYER                 N         S
1965 09 MEASUREMENT           N       M S
1965 06 MOMENTUM                  V M S
1965 10 NOZZLE                N T V M S
1965 07 NUMBER                N   V M S
1965 06 PROFILE                   V M S
1965 10 RATE                      V     S
1965 08 RATIO                     V
1965 06 SOLUTION              N   V     S
1965 08 THICKNESS                 V M
1965 06 THROAT                      M
1965 09 THROUGH                   V     S
1965 06 VELOCITY                  V     S
1966 08 BODY                    T V M S
1966 07 BOUNDARY              N       M
1966 07 BUOYANCY              N   V M
1966 10 CHANNEL               N T V
1966 10 COMPRESSIBILITY       N T V M S
1966 08 CONVECTION            N   V M S
1966 06 COUETTE                   V M S
1966 09 DEVELOPED               T V M
1966 08 FIXED                     V M
1966 09 FLOW                  N T V     S
1966 07 FLUID                     V M
1966 08 FORCE                 N T V M S
1966 08 FRICTIONAL                V M S
1966 09 FULLY                   T V M S
1966 07 GAS                       V     S
1966 07 GRADIENT              N   V M S
1966 06 GRAVITY               N   V
1966 08 HEATING               N   V     S
1966 09 LAMINAR                         S
1966 06 PAST                      V     S
1966 06 POISEUILLE                V     S
1966 07 PRESSURE                  V M S
1966 07 PROPERTY              N T V     S
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1966 08 STREAMWISE                  V M S
1966 07 TEMPERATURE                 V M
1966 07 VARIABLE                  T V   S
1966 07 VARIATION                   V   S
1966 08 WALL                        V M
1967 10 ACCELERATED               T V   S
1967 06 AUGMENTATION            N   V M S
1967 10 AXIAL                       V M
1967 10 BODY                      T   M S
1967 10 CIRCULAR                      M S
1967 09 COMPRESSIBLE              T V M S
1967 10 CONDUCTING                    M
1967 07 DEVELOPED                       S
1967 07 DIFFERENCE              N   V M S
1967 10 ELECTRIC                    V   S
1967 10 ELECTRICALLY                V M S
1967 06 ELECTROMAGNETICALLY         V   S
1967 08 ENTRY                       V   S
1967 06 EXHAUST                 N   V M
1967 10 FIELD                           S
1967 09 FLOW                    N T V M S
1967 09 FLUID                   N   V M S
1967 10 FORCE                   N T V M S
1967 07 FULLY                         M S
1967 10 GAS                     N     M
1967 00 GRADIENT                N       S
1967 06 HARTMANN                    V M
1967 05 HIGH                        V M S
1967 05 INDUCED                       M S
1967 06 IONIZED                     V
1967 09 LAMINAR                   T V   S
1967 07 LENGTH                  N   V M S
1967 10 MAGNETIC                    V M S
1967 10 MAGNETOFLUIDMECHANICS   N   V M
1967 05 NUMBER                  N     M
1967 10 PIPE                    N T V   S
1967 07 PRESSURE                    V M S
1967 07 PROFILE                 N   V M S
1967 06 ROCKET                      V M S
1967 06 SEEDED                      V   S
1967 09 STEADY                      V   S
1967 07 TEMPERATURE             N   V M S
1967 09 THEORY                  N     M S
1967 06 THRUST                          S
1967 07 VELOCITY                N       S
1967 10 VISCOUS                   T V   S
1967 07 WALL                            S
1968 00 ACCELERATION                V
1968 05 APPROACH                N   V   S
1968 08 ARC                         V   S
1968 06 BOOST                   N   V M S
1968 05 CAPABILITY              N   V M S
1968 06 CAPTURE                     V   S
1968 05 CHANGE                      V   S
1968 07 CHARACTERISTIC          N   V M
1968 08 CHEMICAL                    V M S
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1968	05	CONTROL	N		V	M	S
1968	05	CORRECTION	N		V	M	S
1968	06	DECAY	N		V		S
1968	05	DESIGN			V	M	S
1968	05	DURATION			V		S
1968	06	EARTH			V	M	S
1968	05	EFFICIENCY	N		V		S
1968	08	ELECTRICAL			V	M	S
1968	07	ENERGY			V		S
1968	08	ENGINE			V		S
1968	08	ENVIRONMENTAL			V	M	
1968	06	EQUILIBRIUM	N		V	M	S
1968	06	ESCAPE			V	M	S
1968	05	FIELD	N		V		
1968	06	FISSION	N		V	M	S
1968	05	FLEXIBILITY	N		V	M	S
1968	10	FLIGHT	N	T	V	M	S
1968	06	FUSION	N		V	M	S
1968	06	GRAVITY	N		V	M	S
1968	05	GROWTH			V		S
1968	08	HEATING			V		S
1968	05	HIGH			V	M	S
1968	06	IMPULSE	N			M	S
1968	10	INTERJECTORY			V	M	S
1968	10	INTERPLANETARY		T	V		S
1968	08	ION			V	M	S
1968	06	ISOTOPE					S
1968	08	LIGHT			V	M	S
1968	08	LIQUID			V	M	S
1968	08	MAGNETOPLASMA			V	M	S
1968	06	MANOEUVRE	N		V		S
1968	05	MASS				M	S
1968	06	METEORITE	N		V	M	S
1968	06	METEROID	N		V		S
1968	09	MIDCOURSE			V		S
1968	07	MISSION	N		V	M	S
1968	07	MULTIPLE			V		S
1968	08	NUCLEAR			V		S
1968	06	ORBIT			V		S
1968	05	ORIENTATION	N		V	M	S
1968	07	PERFORMANCE	N		V	M	S
1968	05	PLANE	N		V	M	S
1968	06	PLANET			V		S
1968	06	POWER	N			M	S
1968	08	PROPELLANTS			V	M	S
1968	10	PROPULSION	N	T	V	M	S
1968	06	RADIATION	N		V	M	S
1968	06	RADIOACTIVE			V		S
1968	05	RATIO	N		V		S
1968	05	RELATION			V	M	S
1968	08	RELIABILITY	N		V	M	S
1968	07	REQUIREMENT	N		V		S
1968	06	RESTART			V		S
1968	08	REYNOLDS			V	M	S
1968	10	ROCKET	N	T	V	M	S

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1968 08 SAIL                                V M S
1968 08 SOLAR                               V   S
1968 08 SOLID                               V M S
1968 07 SOURCE                              V   S
1968 06 SPECIFIC                            V   S
1968 09 SYSTEM                          N T V M S
1968 06 TARGET                              V M S
1968 06 THERMAL                             V   S
1968 06 THRUST                          N       S
1968 10 TRAJECTORY                      N   V M S
1968 09 TRANSFER                        N   V M S
1968 06 VACUUM                              V M S
1968 05 VECTOR                              V   S
1968 08 VEHICLE                             V   S
1968 06 VELOCITY                            V   S
1968 05 VOLUME                          N   V M
1968 08 WAVE                                    S
1968 06 WEIGHT                          N   V M S
1968 05 ZERO                                V   S
1970 10 AIR                               T V
1970 07 CENTRE
1970 08 CHORDWISE                             M S
1970 06 CONTROL                         N     M S
1970 10 EXHAUSTING                        T V M
1970 10 FLAT                              T   M S
1970 09 FLOW                            N T V   S
1970 06 FORCE                           N     M S
1970 09 FREE                              T V   S
1970 10 INDUCED                           T V M
1970 08 INTERFERENCE                        V M S
1970 10 JET                               T V   S
1970 10 LOAD                            N T V M S
1970 07 LOCATION                        N   V
1970 09 MACH                            N T   M
1970 09 MEASUREMENT                     N   V   S
1970 06 MOMENT                          N   V M
1970 09 NORMAL                            T V M S
1970 08 NOZZLE                              V M
1970 09 PERPENDICULARLY                   T V M
1970 10 PLATE                             T V
1970 07 PRESSURE                        N   V M
1970 07 RATIO                               V M
1970 06 REACTION                            V M S
1970 07 STATIC                              V M
1970 09 STREAM                            T V M S
1970 09 SUBSONIC                              M S
1970 09 SUPERSONIC                          V   S
1970 08 THRUST                          N   V M S
1970 07 TOTAL                                   S
1970 05 TYPE                                V
1970 10 WING                            N T V M S
1971 09 ADJACENT                          T V M S
1971 06 ALTITUDE                            V M S
1971 10 ARROW                                 M S
1971 05 AUGMENTATION                    N       S
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1971 10 BLUNT                                        M S
1971 06 CONTROL                            N     V   M S
1971 09 DISTRIBUTION                       N  T  V
1971 09 EDGE                               N     V   M
1971 09 EFFECT                             N     V   M S
1971 10 EXITING                                  V   M S
1971 10 FLAT                                  T        S
1971 09 FLOW                               N     V   M
1971 09 HYPERSONIC                                     S
1971 10 INTERFERENCE                                   S
1971 10 JET                                N  T      M S
1971 09 LEADING                                  V   M S
1971 05 LOSS                               N     V     S
1971 08 MACH                                  T  V
1971 09 NORMAL                                T      M S
1971 10 NOSE                                     V   M
1971 10 NOZZLE                                   V   M S
1971 07 NUMBER                             N     V     S
1971 10 PLATE                                    V     S
1971 0  PRESSURE                              T  V   M S
1971 09 RATIO                              N     V   M
1971 06 REACTION                                 V   M
1971 10 REENTRY                                  V     S
1971 08 REYNOLDS                                 V   M S
1971 09 SHARP                                    V     S
1971 09 SONIC                                 T      M
1971 09 SUPERSONIC                                   M S
1971 09 SURFACE                            N  T      M S
1971 06 THRUST                                   V
1971 10 VEHICLE                            N     V     S
1971 10 WING                               N         M S
1972 09 AERODYNAMIC                           T  V   M S
1972 07 BOUNDARY                                 V   M
1972 08 CHORDWISE                                V
1972 06 CONTROL                            N     V   M S
1972 07 DISTRIBUTION                             V   M S
1972 09 EFFECT                                T      M S
1972 10 EXHAUSTING                            T  V   M
1972 10 FLAT                                  T  V   M S
1972 09 FLOW                               N     V   M S
1972 08 FORCE                              N     V
1972 09 FREE                                  T  V   M
1972 09 HYPERSONIC                               V     S
1972 10 INTERACTION                           T  V   M S
1972 10 JET                                N  T  V     S
1972 07 LAYER                                    V     S
1972 09 MACH                                  T  V   M S
1972 09 MODEL                              N     V   M S
1972 00 NORMAL                                   V
1972 09 PERPENDICULARLY                       T  V   M
1972 10 PLATE                                 T      M S
1972 07 PRESSURE                           N         M S
1972 07 RATIO                              N     V   M S
1972 08 REACTION                                 V     S
1972 08 SEPARATION                         N         M S
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1972 08 SLOT                      V M S
1972 10 SONIC                   T V M
1972 06 SPACE                       M S
1972 08 STAGNATION                V M
1972 07 STATIC                    V M
1972 09 STREAM                N T V   S
1972 07 SURFACE                     M
1972 09 TEST                  N   V M
1972 08 TRANSITIONAL              V   S
1972 09 TUNNEL                    V M S
1972 07 TURBULENT                 V M S
1972 10 TWODIMENSIONAL            V   S
1972 06 VEHICLE               N   V   S
1972 08 WIDTH                 N   V   S
1972 09 WIND                        M S
1973 07 ANGLE                     V M S
1973 07 ATTACK                N   V   S
1973 09 BALANCE                   V   S
1973 10 BASE                  N T V M S
1973 07 BODY                      V   S
1973 07 BOUNDARY                  V M
1973 06 CONTROL               N       S
1973 10 CYLINDER                T V   S
1973 07 DIAMETER                    M S
1973 06 DRAG                  N     M S
1973 09 EFFECT                N T V M
1973 10 EXHAUSTING              T V M S
1973 09 FLOW                  N   V M
1973 07 FORCE                 N   V M
1973 07 FOREBODY                  V
1973 07 FREE                      V   S
1973 10 INTERACTION             T V   S
1973 10 JET                     T V   S
1973 07 LAMINAR                   V   S
1973 10 LATERALLY               T V M
1973 07 LAYER                 N   V M S
1973 07 LENGTH                N   V M S
1973 07 MACH                      V M S
1973 09 MAIN                    T   M S
1973 09 MEASUREMENT           N   V M S
1973 09 MODEL                 N T V M
1973 06 NUMBER                N   V   S
1973 10 OGIVE                   T V M S
1973 07 PRESSURE                      S
1973 07 RATIO                 N     M
1973 06 REACTION                  V M
1973 06 SEPARATION            N   V   S
1973 10 SIDE
1973 08 STAGNATION                V M S
1973 09 STING                     V M
1973 09 STREAM                  T V M S
1973 09 SUPERSONIC              T V   S
1973 09 TEST                  N   V M S
1973 09 TUNNEL                      M S
1973 07 TURBULENT                 V M
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1973 09 WIND                        V M S
1974 06 ACCOMODATION                V   S
1974 05 ADDITION                N   V M S
1974 05 ANALYSIS                N T   M
1974 07 BOUNDARY                    V M S
1974 07 CALCULATION             N       S
1974 06 CONICAL                         S
1974 10 CONTROL                 N T V
1974 08 EVAPORATING                 V   S
1974 06 EXOTHERMIC                  V M S
1974 07 EXPERIMENTAL                V   S
1974 07 EXTENT                  N   V   S
1974 05 FACTOR                  N   V M S
1974 10 FLUID                     T V M S
1974 08 FORCE                   N   V   S
1974 08 GAS                     N       S
1974 05 HEAT                        V M S
1974 06 HEIGHT                      V M S
1974 06 IMPULSE                 N   V M S
1974 06 INJECTED                    V M S
1974 10 INJECTION               N T V M S
1974 00 INTERACTION             N     M S
1974 07 LAYER                       V
1974 08 LIQUID                      V M
1974 06 MAGNIFICATION               V   S
1974 09 MAIN                        V M
1974 07 MEASUREMENT             N   V   S
1974 06 MOLECULAR                   V M S
1974 10 NOZZLE                  N     M S
1974 07 PRESSURE                N   V M S
1974 06 PRIMARY                     V M S
1974 00 RATE                        V M S
1974 05 RATIO                   N   V   S
1974 06 REACTION                    V M S
1974 07 REGION                  N   V M S
1974 10 ROCKET                      V   S
1974 08 SEPARATED                   V M S
1974 08 SEPARATION              N   V M S
1974 08 SHOCK                       V M S
1974 08 SIDE                        V   S
1974 05 SMALL                       V M S
1974 05 SPECIFIC                    V
1974 09 STREAM                  N   V M S
1974 09 SUPERSONIC                  V   S
1974 10 THRUST                    T V M S
1974 07 TURBULENT                   V   S
1974 10 VECTOR                    T V   S
1974 08 WAVE                        V M S
1974 06 WEIGHT                  N     M S
1978  8 ABLATION                N   V M S
1978 06 BLUNT                       V M S
1978 08 BODY                    N   V M S
1978 09 BOUNDARY                N T V   S
1978 08 COMBUSTION                      S
1978 07 CONDITION               N   V
```

1978	10	CONDUCTION			V		S
1978	10	CONDUCTIVITY	N		V	M	S
1978	06	CONVECTIVE			V	M	S
1978	10	CYLINDER			V		S
1978	09	EQUATION	N		V		
1978	08	EROSION	N			M	S
1978	07	EXTERNAL			V	M	S
1978	09	FINITE		T	V	M	S
1978	07	FLOW			V	M	S
1978	06	FLUX			V		
1978	08	GRAPHITE			V	M	S
1978	09	HEAT			V	M	S
1978	08	HEATING	N		V		S
1978	05	HISTORY	N		V	M	S
1978	06	HYPERSONIC			V		S
1978	07	MATERIAL	N		V	M	
1978	07	MOTION	N		V	M	S
1978	09	MOVING		T	V		S
1978	06	NOSED			V	M	S
1978	09	NUMERICAL			V	M	S
1978	05	POINT	N		V		S
1978	09	PROFILE	N	T	V		
1978	07	RATE	N			M	S
1978	08	REENTRY			V		S
1978	07	REMOVAL			V	M	S
1978	09	SOLID	N	T	V		S
1978	09	SOLUTION	N		V		S
1978	06	STAGNATION			V	M	S
1978	08	SUBLIMATION			V	M	S
1978	08	SURFACE	N		V	M	S
1978	09	TEMPERATURE	N	T	V	M	S
1978	09	THICKNESS	N		V		S
1978	05	TRANSFER			V	M	S
1978	09	TRANSIENT			V		S
1978	09	VARIABLE			V		S
1978	08	VEHICLE			V	M	
1978	07	WALL			V		S
1980	09	ADIABATIC		T	V	M	
1980	09	ARBITRARY		T	V		S
1980	07	AVERAGE			V	M	S
1980	09	COEFFICIENT	N	T		M	S
1980	09	COMPUTATION	N		V		S
1980	10	CONVECTION			V	M	S
1980	06	COPPER			V	M	S
1980	07	FLOW	N		V	M	S
1980	09	FORCED				M	
1980	09	HEAT		T	V		
1980	10	HEATING	N		V		S
1980	09	HISTORY	N		V		
1980	09	HOMOGENEOUS			V	M	S
1980	06	INCONEL			V	M	S
1980	07	SERIES	N		V	M	S
1980	10	SURFACE			V	M	S
1980	10	TEMPERATURE	N	T			S
1980	10	THERMALLY				M	

```
1980 10 THICK               T V
1980 08 THIN                  V M
1980 07 TIME                  V M
1980 09 TRANSFER            T   M S
1980 10 TRANSIENT           T   M S
1980 07 TRIANGLE              V M
1980 07 UNIT                  V M S
1980 09 VARIATION           T   M S
1980 10 WALL              N T
1981 08 AERODYNAMIC           V M S
1981 06 BLUNT                 V M S
1981 10 BODY                  V M S
1981 09 BOUNDARY            T V   S
1981 05 CALCULATION       N     M S
1981 09 CONDITION         N T V   S
1981 08 CONDUCTION          T V
1981 06 CONE              N   V   S
1981 09 CONSTANT              V   S
1981 09 DEPENDENT           T V M
1981 09 DISTRIBUTION      N   V M
1981 07 EQUATION          N T V M S
1981 09 FLOW              N
1981 10 HEAT                T   M S
1981 08 HEATING           N   V   S
1981 09 MATERIAL              V M
1981 06 NOSE                  V M S
1981 10 ONEDIMENSIONAL        V M S
1981 06 POINT                     S
1981 09 PROPERTY          N   V   S
1981 10 SLAB              N
1981 10 SOLID                 V M S
1981 09 SOLUTION          N T   M
1981 06 STAGNATION            V M S
1981 10 TEMPERATURE             M S
1981 09 THEORETICAL           V M S
1981 06 THIN                  V M S
1981 09 TIME                T V   S
1981 10 TRANSIENT             V M S
1981 06 WING              N   V M
1982 10 AERODYNAMIC           V   S
1982 10 ATMOSPHERE        N T V M S
1982 07 BACK                  V   S
1982 07 BOUNDARY              V M S
1982 09 CALCULATION       N       S
1982 08 CONDUCTION        N     M
1982 06 COPPER                  M S
1982 07 DISTRIBUTION      N       S
1982 10 EARTH                 V   S
1982 10 ENTERING              V M S
1982 07 FINITE                V   S
1982 07 FUNCTION                  S
1982 07 GENERALIZED           V M S
1982 06 GRAPHITE              V M S
```

1982	07	GREEN				M	S
1982	10	HEAT			V	M	S
1982	10	HEATING	N	T		M	S
1982	09	HISTORY		T	V	M	S
1982	10	HYPERSONIC			V		
1982	07	INTEGRATION			V	M	S
1982	10	LAMINAR		T	V		S
1982	07	LAYER			V	M	S
1982	07	MATERIAL			V	M	S
1982	07	MAXIMUM			V		S
1982	06	MOLYBDENUM			V	M	S
1982	07	ONEDIMENSIONAL			V	M	S
1982	09	OUTER			V	M	S
1982	05	PERFORMANCE	N				S
1982	09	PROFILE	N			M	
1982	07	PROPERTY	N		V	M	S
1982	08	RADIATION	N				S
1982	07	RATE	N		V	M	S
1982	10	REENTRY			V	M	
1982	10	SINK	N		V	M	S
1982	10	SKIN		T	V		S
1982	07	SOLUTION	N		V	M	S
1983	10	BODY					S
1983	10	EARTH				M	
1983	08	ENTHALPY	N		V		S
1983	08	EXPERIMENT	N		V	M	S
1983	08	FLIGHT			V	M	S
1983	09	HEAT		T			S
1983	08	HYPERSONIC			V	M	S
1983	07	MEASUREMENT	N			M	
1983	10	POINT					S
1983	07	PRESSURE	N		V	M	S
1983	09	RATE	N			M	S
1983	10	REENTRY					S
1983	10	REVOLUTION					S
1983	10	SATELLITE		T		M	S
1983	09	SHOCK			V		S
1983	07	SOLUTION	N		V	M	S
1983	10	STAGNATION			V	M	S
1983	07	THEORETICAL					
1983	09	TRANSFER		T	V		
1983	09	TUBE			V	M	S
1983	10	VEHICLE	N	T	V	M	S
1983	08	VELOCITY	N		V	M	S
1984	09	ANALYSIS	N	T	V		S
1984	08	BLADE			V		S
1984	10	CENTRIFUGAL		T		M	
1984	06	CHOKED				M	S
1984	10	COMPRESSIBLE		T	V	M	S
1984	10	COMPRESSOR	N		V	M	S
1984	08	CURVATURE	N		V	M	S
1984	07	DISTRIBUTION	N		V	M	S
1984	09	FLOW	N	T	V		S
1984	08	FORCE	N			M	S

```
1984 07 GRADIENT        N   V M S
1984 10 HUB                 V M
1984 10 IMPELLER          T V M S
1984 10 INLET           N   V M
1984 10 ISENTROPIC
1984 07 MAXIMUM             V   S
1984 09 MERIDIONAL            M S
1984 10 MIXED             T V
1984 08 PLANE           N   V   S
1984 07 PRESSURE        N   V   S
1984 07 PROFILE         N     M S
1984 08 ROTATIONAL          V   S
1984 06 SEPARATION      N   V   S
1984 07 SEVERE                  S
1984 10 SHROUD          N   V   S
1984 08 STREAMLINE      N   V M S
1984 07 SURFACE         N     M S
1984 08 TANGENTIAL          V M S
1984 09 THEORETICAL         V   S
1984 08 VELOCITY            V
1984 07 WEIGHT                  S
1985 08 ANGLE           N   V M S
1985 10 BLADE           N T V M
1985 07 CARRYING                S
1985 10 CENTRIFUGAL       T V M
1985 10 COMPRESSIBLE        V   S
1985 10 COMPRESSOR      N   V M S
1985 09 DESIGN          N T V M
1985 07 DISTRIBUTION    N   V M S
1985 06 EXIT                V M S
1985 09 FILAMENT                S
1985 09 FLOW            N     M
1985 08 FORCE               V M S
1985 07 GRADIENT        N
1985 10 HUB             N T V   S
1985 10 IMPELLER        N T     S
1985 08 INLET               V   S
1985 10 ISENTROPIC          V   S
1985 07 MAXIMUM             V   SA
1985 08 MERIDIONAL          V M S
1985 08 MIXED               V M S
1985 10 NONVISCOUS          V   S
1985 07 OVERALL             V M S
1985 08 PARABOLIC           V M S
1985 08 PLANE                 M S
1985 07 PRESCRIBED          V M S
1985 07 PRESSURE              M S
1985 09 PROFILE         N T V   S
1985 05 RELATIVE            V   S
1985 10 SHAPE           N T   M S
1985 08 SHAPED              V   S
1985 10 SHROUD            T V
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1985 06 SLIP            N   V M S
1985 08 SPACING         N     M S
1985 09 STREAM              V M
1985 08 STREAMLINE          V M S
1985 08 STREAMTUBE          V   S
1982 08 SURFACE
1982 10 TEMPERATURE
1982 09 THICK
1982 08 THICKNESS
1982 08 TRAJECTORY
1982 08 WALL
1982 06 TUNGSTEN            V
1982 10 VEHICLE         N   V M S
1983 10 BLUNT               V M S
1983 10 ATMOSPHERE      N T V   S
1983 08 ALTITUDE        N   V M
1985 09 THEORY          N     M
1985 08 TANGENTIAL          V M S
1985 08 VELOCITY        N   V M S
1985 08 WEIGHT              V M S
1986 06 DECELERATION        V   S
1986 09 DESIGN          N T V M S
1986 08 ADIABATIC           V   S
1986 08 BLADE                   S
1986 10 BLADING         N     M S
1986 10 DIFFUSER        N   V M S
1986 10 BRADING         N   V M S
1986 10 CENTRIFUGAL         V   S
1986 10 CIRCULAR            V
1986 10 COMPRESSOR      N     M S
1986 08 DRIVING             V   S
1986 08 EDDY                  M S
1986 07 EFFICIENCY      N   V   S
1986 07 ELIMINATION         V M S
1986 08 FACE            N   V
1986 09 FLOW            N T   M S
1986 07 FORMATION           V M S
1986 09 GRADIENT
1986 10 HUB             N     M S
1986 10 IMPELLER          T   M S
1986 09 IMPROVED            V M S
1986 10 INLET               V M S
1986 10 ISENTROPIC            M S
1986 07 MAXIMUM             V M S
1986 10 MIXED             T V M
1986 07 OPERATION           V M S
1986 10 OUTLET          N   V M S
1986 10 PARABOLIC               S
1986 08 PEAK                V M S
1986 08 POTENTIAL               S
1986 00 PRESSURE            V   S
1986 07 RANGE           N   V M S
```

1986	07	RATIO	N		V	M	S
1986	09	REDUCTION				M	S
1986	08	RISE				M	S
1986	06	ROTATING			V	M	
1986	06	SEPARATION	N			M	S
1986	10	SHROUD		T	V	M	S
1986	10	SKEWED			V	M	S
1986	06	STALL	N		V		S
1986	06	SURGE	N			M	S
1986	08	TEMPERATURE			V	M	S
1986	10	VANELESS				M	S
1986	10	VELOCITY			V		S
1986	08	WEIGHT					S
1986	07	WIDE			V	M	S
1987	07	ABSOLUTE					
1987	08	AEROTHERMODYNAMIC			V	M	S
1987	10	AXIAL		T	V	M	
1987	07	BASIC			V	M	
1987	08	BLADE			V	M	
1987	10	COMPRESSOR			V	M	S
1987	07	EQUATION	N		V	M	S
1987	09	FLOW	N	T	V	M	S
1987	09	FLUID	N		V	M	
1987	08	INLET					S
1987	08	IRROTATIONAL			V	M	S
1987	10	MIXED		T	V		S
1987	10	NONVISCOUS					S
1987	07	POTENTIAL				M	S
1987	10	RADIAL		T	V	M	S
1987	07	RELATION	N		V	M	S
1987	09	RELATIVE			V	M	S
1987	08	ROTATING			V	M	S
1987	08	ROTATIONAL			V		S
1987	08	ROW	N		V		
1987	09	SOLUTION	N		V	M	S
1987	09	STEADY			V	M	S
1987	09	STREAM			V	M	
1987	09	SUBSONIC		T	V	M	S
1987	09	SUPERSONIC		T		M	S
1987	09	SURFACE	N		V		S
1987	09	THEORETICAL				M	
1987	10	THREEDIMENSIONAL		T	V	M	S
1987	10	TURBOMACHINE		T		M	S
1987	09	TWODIMENSIONAL			V	M	S
1988	09	ANALYSIS	N				S
1988	06	ANGLE	N		V	M	S
1988	08	ATTACK	N		V	M	
1988	10	AXIAL			V	M	S
1988	10	BLADE		T			S
1988	07	CALCULATION	N		V	M	S
1988	07	CONDITION	N		V	M	S
1988	07	DISTRIBUTION	N		V	M	S

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1988 08 DRIVING                                          V M
1988 08 EDDY                                             V   S
1988 08 EDGE                                             V M S
1988 08 FACE                                         N   V   S
1988 07 FACTOR                                       N   V M S
1988 09 FLOW                                         N T   M S
1988 07 FUNCTION                                     N   V
1988 06 HEAD                                                 S
1988 10 IMPELLER                                       T V M
1988 09 INCOMPRESSIBLE                                     M S
1988 10 INLET                                            V   S
1988 07 LARGE                                              M S
1988 08 LOCATION                                         V   S
1988 05 MAXIMUM                                              S
1988 10 MIXED                                            V M S
1988 10 NONVISCOUS                                     T V M S
1988 06 OUTLET                                           V M S
1988 05 PARAMETER                                    N   V M S
1988 08 POINT                                        N   V M S
1988 07 POSITIVE                                         V   S
1988 08 POTENTIAL                                        V M S
1988 08 PRESSURE                                         V M S
1988 08 PREWHIRL                                     N   V M S
1988 10 PROPELLANTS                                      V M S
1988 10 PUMP                                           T V M S
1988 05 RATIO                                            V   S
1988 08 REAR                                                 S
1988 05 RELATIVE                                         V M S
1988 09 REVOLUTION                                   N T   M S
1988 06 RISE                                             V M S
1988 10 ROCKET                                           V
1988 10 ROTOR                                        N   V   S
1988 08 SLIP                                             V   S
1988 08 STAGNATION                                       V M
1988 08 STREAM                                           V   S
1988 09 SURFACE                                        T V M
1988 08 TRAILING                                           M S
1988 06 UPSTREAM                                         V M S
1988 08 VELOCITY                                     N   V M S
1989 09 ADJACENT                                         V
1989 09 ANALYSIS                                     N   V M S
1989 08 ANGLE                                            V M
1989 08 ATTACK                                       N   V   S
1989 10 BLADE                                        N   V   S
1989 07 DISTRIBUTION                                 N   V M S
1989 07 DIVISION                                             S
1989 06 DRIVING                                          V   S
1989 06 EDDY                                             V M
1989 08 EDGE                                             V M S
1989 06 FACE                                             V   S
1989 07 FACTOR                                       N   V   S
1989 09 FLOW                                         N T V M S
1989 05 FORMATION                                        V M S
1989 06 HEAD                                             V
1989 10 IMPELLER                                     N   V M S
1989 09 INCOMPRESSIBLE                                 T V   S
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1989 08 INLET                 V M S
1989 08 LOADING                   S
1989 08 LOCATION              V M S
1989 09 MAIN                  V M S
1989 10 MIXED                 V M S
1989 10 NONVISCOUS          T V M
1989 08 POINT             N   V M S
1989 08 PREWHIRL          N   V M S
1989 10 PUMP                T V M S
1989 08 REAR                  V M S
1989 09 REVOLUTION        N   V M S
1989 06 RISE              N   V   S
1989 08 ROTATIONAL            V M S
1989 10 ROTOR               T V
1989 08 SLIP                  V   S
1989 08 SPEED             N   V   S
1989 10 SPLITTER          N T V M S
1989 08 STAGNATION            V
1989 09 SURFACE           N   V M S
1989 09 THEORETICAL           V M S
1989 08 TIP               N   V M S
1989 08 TRAILING                M S
1989 08 UPSTREAM                M S
1989 10 VANE                T     S
1989 07 VARIATION         N   V M S
1989 08 VELOCITY          N     M S
1989 08 WEIGHT                    S
1989 08 WHIRL             N       S
1990 09 ARBITRARY             V   S
1990 10 BLADE             N T V M S
1990 09 CALCULATION       N   V   S
1990 10 CENTRIFUGAL         T   M S
1990 09 COMPRESSIBLE            M
1990 10 COMPRESSOR        N T   M
1990 09 CONTOUR           N   V
1990 08 CURVATURE         N   V   S
1990 09 DISTRIBUTION      N T V   S
1990 09 FLOW              N   V   S
1990 09 HUB                   V   S
1990 10 IMPELLER            T V   S
1990 09 INCOMPRESSIBLE        V   S
1990 07 METHOD            N T   M S
1990 10 MIXED                   M
1990 10 NONVISCOUS            V
1990 07 NUMBER                V M S
1990 10 RADIAL                V
1990 07 RATE              N   V M S
1990 07 RELAXATION              M S
1990 09 SHAPE             N   V M S
1990 09 SHROUD                    S
1990 08 SPEED             N   V M
1990 10 SURFACE           N       S
1990 09 THEORETICAL           V M S
1990 08 TIP               N     M S
1990 10 TWODIMENSIONAL        V M S
1990 10 VELOCITY            T   M S
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1991 10 AIR                       T V   S
1991 10 BODY                          M
1991 07 DISTRIBUTION            N   V   S
1991 10 DRAG                    N T V   S
1991 09 ENERGY                      V   S
1991 06 EXIT                    N   V M
1991 09 FLOW                    N T   M S
1991 05 FREE                        V   S
1991 09 HIGH                        V
1991 10 JET                     N T V
1991 06 MIXING                          S
1991 09 MODEL                   N     M S
1991 10 NOSE                    N T V M S
1991 05 NUMBER                  N   V   S
1991 09 PRESSURE                  T V M
1991 05 PROCESS                     V   S
1991 10 PROJECTION                  V M
1991 10 PROLATE                   T V M
1991 09 REDUCTION               N T V M S
1991 05 RELATIVE                    V
1991 06 REYNOLDS                      M S
1991 08 SHADOWGRAPH                   M S
1991 06 SHEAR                       V M S
1991 06 SIZE                    N   V   S
1991 06 SLOPE                   N   V M
1991 10 SPHEROID                  T V M S
1991 05 STREAM                  N   V   S
1991 09 STUDY                   N T   M S
1991 05 SUPERSONIC                  V M S
1991 05 TEST                    N   V M S
1991 08 THRUST                  N   V M
1991 10 TRANSONIC                 T     S
1991 05 TUNNEL                        M S
1991 05 WIND                        V M
1991 10 WING                      T
1992 10 AIR                       T V M S
1992 10 BODY                      T V M S
1992 07 BOUNDARY                      M S
1992 07 COEFFICIENT             N       S
1992 05 DISTRIBUTION            N   V M S
1992 08 DRAG                    N   V M S
1992 10 ELLIPTICAL                  V M S
1992 10 EXHAUSTING                T V M
1992 09 FLOW                      T V M S
1992 08 FOREBODY                    V M S
1992 10 FORWARD                     V M
1992 08 FRICTION                    V M S
1992 10 JET                       T V   S
1992 07 LAYER                       V   S
1992 09 MACH                    N   V   S
1992 10 NOSE                      T     S
1992 07 NUMBER                  N       S
1992 05 PATTERN                 N     M S
1992 05 PHENOMENA               N     M S
1992 06 PHOTOGRAPH              N   V M S
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1992 09 POINT                          N   V M S
1992 07 PRESSURE                           V
1992 10 REVOLUTION                     N T V   S
1992 08 REYNOLDS                           V M S
1992 06 SCAVENGING                         V M
1992 06 SCHLIEREN                          V M
1992 08 SKIN                               V M S
1992 09 SMALL                            T V   S
1992 09 STAGNATION                         V M S
1992 09 SUPERSONIC                       T V M S
1992 05 SURFACE                            V   S
1992 09 TEST                           N   V
1992 08 THRUST                             V M S
1992 07 TOTAL                                M
1992 08 TRANSITION                     N   V M S
1992 09 TUNNEL                             V M S
1992 08 VISCOUS                            V M
1992 09 WIND
1993 10 AFTERBODY                      N T V M S
1993 07 ANGLE                            T V   S
1993 07 ATTACK                         N T V M S
1993 08 BASE                               V   S
1993 08 BODY                               V M S
1993 06 BOW                                V M S
1993 10 CYLINDRICAL                      T V M S
1993 06 DETACHMENT                           M S
1993 07 DIAMETER                       N   V   S
1993 06 DISTANCE                       N   V M S
1993 07 DISTRIBUTION                   N   V M S
1993 10 EXHAUSTING                         V M
1993 08 EXIT                               V M S
1993 07 FIELD                          N   V M S
1993 09 FLOW                               V   S
1993 09 FREE                               V M S
1993 08 INTERFERENCE                       V M S
1993 10 JET                              T   M S
1993 08 LEEWARD
1993 09 MACH                           N   V M S
1993 10 NOZZLE                           T V   S
1993 07 NUMBER                         N
1993 08 PHOTOGRAPH                     N   V
1993 07 PRESSURE                       N   V   S
1993 07 RATIO                                M S
1993 08 REYNOLDS                           V M S
1993 08 SCHLIEREN                          V M
1993 08 SHOCK                              V
1993 00 SONIC                            T V
1993 07 STATIC                             V M S
1993 09 STREAM                         N T V   S
1993 07 STRUCTURE                      N   V M S
1993 09 SUPERSONIC                       T V M S
1993 09 TEST                           N   V M S
1993 07 TOTAL                              V M
1993 09 TUNNEL                             V M
1993 08 WAVE                               V M S
1993 09 WIND                               V M S
```

1993	08	WINDWARD			V		S
1994	08	AFTERBODY			V		S
1994	10	BLUNT		T	V	M	S
1994	10	BODY	N	T	V	M	S
1994	06	DECELERATION	N		V	M	S
1994	09	DISTRIBUTION	N			M	S
1994	10	DRAG	N		V		S
1994	10	EXHAUSTING		T	V		
1994	07	FIELD	N				S
1994	09	FLOW	N			M	S
1994	08	FOREBODY			V		
1994	09	FREE		T	V	M	S
1994	10	JET			V	M	S
1994	09	LONGITUDINAL				M	S
1994	07	MACH			V	M	S
1994	09	NOSE		T	V	M	S
1994	06	NUMBER	N			M	S
1994	09	PRESSURE			V	M	
1994	09	RADIAL				M	
1994	08	RESULTANT			V		S
1994	10	RETROROCKET	N	T	V		S
1994	09	SEGMENT			V		S
1994	06	SPACE					S
1994	10	SPHERICAL			V	M	
1994	08	STABILITY	N		V	M	S
1994	09	STREAM	N	T	V	M	S
1994	09	SUPERSONIC		T			
1994	09	TEST	N		V	M	S
1994	10	THRUST	N		V		
1994	09	TUNNEL			V		S
1994	06	VEHICLE	N		V	M	S
1994	09	WIND			V		
1995	09	AERODYNAMIC		T	V		S
1995	10	AIR				M	
1995	07	ATTACK	N		V	M	S
1995	08	AXIAL			V	M	
1995	10	BODY		T	V	M	S
1995	08	BOW			V	M	S
1995	09	CHARACTERISTIC	N	T	V	M	S
1995	07	COEFFICIENT	N		V	M	S
1995	08	COLD			V		S
1995	08	CONVERGING			V	M	S
1995	10	COUNTERCURRENT			V		S
1995	08	DECELERATION				M	
1995	07	DISTANCE	N		V		S
1995	07	DISTRIBUTION	N		V		S
1995	08	DIVERGING				M	S
1995	08	DRAG	N		V		S
1995	10	EXHAUSTING			V	M	S
1995	08	EXPANSION			V	M	S
1995	09	FACE	N		V	M	S
1995	09	FLOW	N		V		S

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1995 08 FORCE                      N   V M S
1995 10 FORWARD                        V   S
1995 07 FREE                           V M S
1995 08 INTERFERENCE                   V   S
1995 08 JET                            V M
1995 07 MACH                         T V   S
1995 08 MOMENT                     N   V   S
1995 08 NOZZLE                     N       S
1995 06 NUMBER                     N T V M S
1995 07 PHENOMENA                  N     M S
1995 08 PITCHING                       V M S
1995 07 PRESSURE                   N   V M S
1995 10 RETROROCKET                  T V   S
1995 10 REVOLUTION                 N T   M
1995 10 SEMIELLIPSOID                  V   S
1995 08 SHOCK                          V M
1995 10 SIMULATED                    T V M S
1995 08 STANDOFF                         M
1995 10 STREAM                     N   V   S
1995 09 SUBSONIC                       V   S
1995 09 SUPERSONIC                     V M
1995 09 TEST                       N   V M S
1995 07 TOTAL                            M S
1995 09 TUNNEL                           M S
1995 08 WAVE                               S
1995 09 WIND                           V M S
1997 10 AIR                        N   V   S
1997 08 ANGLE                      N   V M S
1997 10 AXISYMMETRIC                 T V M S
1997 08 BASE                           V   S
1997 06 BOATTAIL                       V   S
1997 08 BOUNDARY                   N   V M S
1997 07 CALCULATION                N   V M S
1997 06 CHARACTERISTIC             N   V   S
1997 08 CONICALLY                      V M
1997 00 CURVATURE                  N   V M S
1997 08 DIVERGENCE                     V M S
1997 08 DIVERGENT                      V M S
1997 08 DOWNSTREAM                     V M S
1997 08 EFFECT                     N   V   S
1997 07 EVALUATION                 N   V   S
1997 10 EXHAUSTING                     V M S
1997 08 EXIT                       N     M S
1997 08 EXPERIMENT                 N   V M S
1997 08 FAR                            V M S
1997 10 FREE                         T V   S
1997 08 HEAT                           V M S
1997 08 HYPERSONIC                     V   S
1997 08 INCLINATION                    V   S
1997 08 INITIAL                          M S
1997 06 INTERFACE                      V   S
1997 08 INTERFERENCE                   V
1997 10 JET                        N T V   S
1997 06 JOHANNESEN                     V   S
1997 06 LOCATION                       V   S
1997 10 MACH                           V M S
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1997 06 METHOD            N   V   S
1997 06 MEYER                   M S
1997 06 MIXING                  M S
1997 06 NOISE             N   V   S
1997 08 NOZZLE            N   V M S
1997 09 NUMBER            N   V M S
1997 06 PHOTOGRAPH        N   V M S
1997 08 PRESSURE          N   V
1997 08 RATIO             N     M S
1997 06 REFLECTION            V M S
1997 06 RIEMANN               V M S
1997 06 SCHLIEREN             V   S
1997 08 SHAPE             N   V M S
1997 08 SHOCK             N   V   S
1997 06 SIMULATION        N   V   S
1997 08 SONIC                 V M S
1997 08 SPECIFIC                  S
1997 08 STATIC                V M S
1997 10 STILL                 V M S
1997 10 STREAM            N   V   S
1997 08 STRUCTURE         N     M S
1997 08 SUPERSONIC            V   S
1997 08 SURFACE               V   S
1997 09 THEORY            N       S
1997 08 VEHICLE           N   V   S
1997 06 WAVE              N   V M S
1997 08 WAVELENGTH        N   V M S
1997 06 WITHIN                V   S
2001 08 AFTERBODY         N   V M S
2001 10 ANGLE               T V M S
2001 06 APPARATUS         N   V M S
2001 04 ATMOSPHERE        N   V M S
2001 08 ATTACK                V M
2001 08 AXIAL                 V   S
2001 08 BASE              N     M S
2001 10 BLUNTED             T V M
2001 10 CHARACTERISTIC    N T V   S
2001 10 CONE              N T V   S
2001 04 CONFIGURATION     N   V M S
2001 08 CONICAL                 M S
2001 08 DAMPING               V M S
2001 10 DEGREE            N T V M S
2001 06 DESIGN            N   V   S
2001 06 DESTABILIZING         V   S
2001 10 DYNAMIC             T   M
2001 06 EFFECT            N   V M
2001 04 ENTRY                 V
2001 08 FLAT                  V M S
2001 08 FORCE             N   V   S
2001 09 INVESTIGATION     N T V   S
2001 08 MACH              N   V
2001 06 MODEL             N   V M S
2001 00 MODIFIED              V M S
2001 08 MOMENT            N   V M
2001 08 NORMAL                  M S
2001 04 PHASE                 V M S
2001 08 PITCHING                M S
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2001 04 PLANETARY                            V M S
2001 08 PRESSURE                         N   V   S
2001 04 PROBE                                V M S
2001 08 RANGE                                V
2001 08 SEGMENT
2001 10 SEMIVERTEX                         T V   S
2001 08 SPHERICAL                                S
2001 10 STABILITY                          T V M S
2001 10 STATIC                             T V M
2001 04 TERMINAL                             V M
2001 08 TRUNCATED                              M S
2001 09 TUNNEL                             T
2001 04 VEHICLE                              V   S
2001 09 WIND                               T V M S
2002 08 AXISYMMETRIC                           M S
2002 10 BLUNT                                V M
2002 10 BODY                             N T V M S
2002 09 DISTRIBUTION                     N   V M S
2002 08 DRAG                             N   V   S
2002 08 FACED                                V   S
2002 08 FLAT                                 V M
2002 09 FLOW                                 V   S
2002 08 FORM                                 V M S
2002 09 HEAT                                 V M S
2002 08 HEMISPHERICALLY                      V   S
2002 09 HYPERSONIC                         T V M S
2002 09 LENGTH                           N     M S
2002 09 MACH                             N   V   S
2002 09 MEASUREMENT                      N   V M S
2002 08 NOSED                                V
2002 09 PRESSURE                             V M S
2002 08 SEPARATION                       N   V M S
2002 10 SPIKE                                  M S
2002 10 SPIKED                             T     S
2002 09 TRANSFER                         N   V M S
2002 09 TUNNEL                               V   S
2002 09 WIND                                 V M S
2061 10 ACTIVE                               V
2061 09 AMBIENT                              V M
2061 08 CHEMICAL                           T   M
2061 10 CHEMICALLY                             M S
2061 08 CONCENTRATION                        V M S
2061 07 CONTINUITY                       N     M S
2061 07 DIMENSIONLESS                        V M S
2061 07 ENERGY                               V M S
2061 09 EQUATION                         N   V   S
2061 10 EXHAUST                            T V
2061 07 FORM                             N     M
2061 10 GAS                              N   V M SA
2061 07 HEAT                                 V M S
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2061 10 ISSUING                         V   S
2061 10 JET                         N T   M
2061 07 MASS                            V   S
2061 10 MIXING                        T V M
2061 07 MOMENTUM                        V   S
2061 07 NET                             V M S
2061 07 PRODUCTION                      V M S
2061 07 PROFILE                     N   V M S
2061 07 RATE                                S
2061 10 REACTING                            S
2061 08 REACTION                    N T V M S
2061 07 RELEASE                         V   S
2061 10 ROCKET                        T V M
2061 07 SPECIES                     N   V   S
2061 07 STATE                       N     M S
2061 09 STREAM                      N T V M S
2061 09 SUPERSONIC                    T   M S
2061 07 TEMPERATURE                     V M S
2061 10 TURBULENT                     T V M S
2061 10 TWODIMENSIONAL                    M
2061 08 VELOCITY                          M S
2074 10 ABOVE                       N   V M S
2074 08 ANGLE                       N   V M S
2074 09 APPROXIMATE                     V   S
2074 10 BODY                          T V M
2074 09 CALCULATION                 N   V M S
2074 10 COMBINATION                         S
2074 08 CONE                        N       S
2074 08 CURVATURE                       V M S
2074 08 CYLINDER                        V M S
2074 08 DISTRIBUTION                N   V M
2074 08 EDGE                            V
2074 06 EXPANSION                       V M S
2074 09 EXPERIMENT                  N   V M S
2074 08 FIELD                       N   V M S
2074 09 FLOW                        N   V   S
2074 06 GENERALIZED                     V   S
2074 10 INTERFERENCE                N T V   S
2074 06 INTERSECTING                    V M
2074 08 LEADING                         V M S
2074 06 LOCAL                           V   S
2074 10 MACH                        N   V   S
2074 06 METHOD                      N   V M S
2074 08 NONLIFTING                      V M S
2074 06 PERPENDICULAR                       S
2074 08 PRESSURE                        V M S
2074 10 SECONDORDER                   T V M S
2074 06 SHOCK                           V   S
2074 08 SMALL                           V M S
2074 09 SOLUTION                    N   V M S
2074 08 SPANWISE                            S
2074 09 SUPERSONIC                    T V M S
2074 08 SWEEP                           V M S
2074 06 TANGENT                         V M
2074 09 TUNNEL                            M S
2074 06 TWO                               M S
2074 06 TWODIMENSIONAL                      S
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2074 06 WEDGE                                           V  M  S
2074 09 WIND                                            V  M  S
2074 10 WING                                   N  T  V  M  S
2075 08 ANGLE                                           V  M  S
2075 10 BODY                                   N  T  V     S
2075 09 CALCULATION                            N     V     S
2075 08 COMBINATION                            N     V  M  S
2075 10 DEGREE                                 N
2075 10 DISTRIBUTION                           N        M
2075 09 EXPERIMENT                             N
2075 06 FIELD
2075 09 FLOW                                   N     V     S
2075 06 GRADIENT                               N     V     S
2075 10 INCIDENCE                                 T  V  M  S
2075 10 INTERFERENCE                           N  T  V  M  S
2075 08 MACH                                   N        M  S
2075 10 NONLIFTING                                T  V  M  S
2075 10 ORDER                                     T     M  S
2075 10 PRESSURE                                        M
2075 00 RANGE                                        V  M  S
2075 10 SECOND                                    T        S
2075 09 SUPERSONIC                                   V  M  S
2075 08 SWEEPBACK                              N
2075 09 THEORETICAL                               T  V     S
2075 09 THEORY                                 N     V     S
2075 07 TUNNEL                                       V  M
2075 07 WIND                                         V
2075 10 WING                                   N  T        S
2076 09 APPROXIMATE                               T  V
2076 08 ARC                                             M
2076 09 BOUNDARY                                  T  V     S
2076 09 CALCULATION                            N     V  M
2076 08 CIRCULAR                                     V  M
2076 09 COMPRESSIBLE                                 V     S
2076 08 CURVED                                       V  M
2076 08 DISPLACEMENT                              T  V  M  S
2076 08 DISTRIBUTION                           N           S
2076 08 DRAG                                   N  T  V  M  S
2076 08 FLAT                                         V  M  S
2076 09 FLOW                                   N  T  V     S
2076 08 FRICTION                                     V  M  S
2076 09 HYPERSONIC                                T  V  M  S
2076 10 INSULATED                                    V     S
2076 09 LAMINAR                                   T  V  M
2076 09 LAYER                                  N  T  V  M
2076 09 LINEAR                                       V  M  S
2076 08 MACH                                   N     V  M  S
2076 08 MOMENTUM                                        M  S
2076 08 PLATE                                  N     V     S
2076 08 PRESSURE                                     V  M  S
2076 08 PROFILE                                N     V  M  S
2076 08 SKIN                                         V     S
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2076 10 SURFACE                       N   V M S
2076 07 TEST                              V M S
2076 08 THICKNESS                     N   V M S
2076 07 TUNNEL                            V
2076 10 TWODIMENSIONAL                  T V
2076 09 VELOCITY                          V M S
2076 08 VISCOUS                         T V M S
2076 07 WIND                              V M
2077 08 ANGLE                           T V M S
2077 00 ARDC                              V M
2077 08 ATMOSPHERE                    N T V M
2077 10 ATTACHED                        T V M
2077 08 ATTACK                          T   M S
2077 07 CONTROL                               S
2077 08 DEGREE                        N   V M S
2077 08 DIHEDRAL                        T V   S
2077 08 EDGE                              V M
2077 08 EFFECTIVE                         V M
2077 08 EQUILIBRIUM                     T V M S
2077 08 GAS                           N T V M S
2077 08 HEAT                              V   S
2077 08 INFINITE                          V   S
2077 08 LEADING                           V M
2077 07 LIFTING                           V M
2077 08 MACH                          N     M
2077 09 METHOD                          T     S
2077 08 MODEL                             V M S
2077 10 OBLIQUE                         T V
2077 08 PARAMETER                     N   V M SA
2077 08 RANGE                             V M
2077 08 RATIO                             V M
2077 08 REAL                            T V M S
2077 10 RESULT                        N T V M S
2077 08 SHARP                                 S
2077 10 SHOCK                           T V M
2077 09 SOLUTION                      N T   M
2077 08 SPECIFIC                          V M
2077 07 SURFACE                       N T V M
2077 08 SWEEP                           T V   S
2077 10 SYSTEM                        N T   M
2077 10 TABLE                             V   S
2077 10 WAVE                            T V M
2077 08 WING                          N   V   S
2078 08 ATTACHED                          V   S
2078 10 CIRCULAR                        T V   S
2078 06 COEFFICIENT                         M S
2078 06 CONTOUR                       N     M S
2078 10 CYLINDER                      N T V M S
2078 06 DISTRIBUTION                      V M S
2078 08 DOWNSTREAM                        V   S
2078 06 DRAG                                M
2078 09 EQUATION                      N   V   S
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2078 10 FLOW                N T V M
2078 10 FLUID               N T V M
2078 10 INCOMPRESSIBLE            M S
2078 08 LENGTH                  V M S
2078 10 NAVIERSTOKES            V M S
2078 09 NUMERICAL               V M
2078 08 PAIR                    V
2078 08 PORTION                 V M S
2078 06 PRESSURE                V M S
2078 10 REYNOLDS            N T   M S
2078 09 SOLUTION            N
2078 08 STATIONARY                M S
2078 10 STEADY                T V M S
2078 06 SURFACE             N   V M S
2078 06 VELOCITY                V M S
2078 10 VISCOUS               T     S
2078 08 VORTEX                  V M
2078 06 VORTICITY                   S
2078 06 WAKE                N   V   S
2080 06 BOUNDARY                V M
2080 09 CALCULATION         N   V M S
2080 08 CIRCULATING             V M S
2080 08 COEFFICIENT         N     M S
2080 08 COORDINATE          N       S
2080 08 DEVELOPMENT               M S
2080 08 DIFFERENCE                M
2080 08 DISTRIBUTION        N   V M S
2080 08 DRAG                    V   S
2080 08 FINITE                  V M S
2080 10 FLOW                N T V   S
2080 08 FORWARD                 V M S
2080 08 FUNCTION            N     M S
2080 06 LAYER               N   V M S
2080 10 LOW                   T V M S
2080 10 METHOD              N       S
2080 08 MODIFIED                V   S
2080 10 NUMBER              N T V   S
2080 08 POLAR                   V M S
2080 08 PRESSURE                V   S
2080 10 RELAXATION                  S
2080 10 REYNOLDS              T V   S
2080 08 SEPARATION              V M
2080 10 SPHERE              N T V M S
2080 08 SPHERICAL               V
2080 08 STREAM                  V   S
2080 06 SYMMETRICAL             V M S
2080 06 TRANSITION              V M
2080 00 VELOCITY                V M S
2080 10 VISCOUS               T V M S
2080 08 VORTICITY                 M S
2080 08 WAKE                N   V M
2081 07 BOUNDARY                V   S
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2081 10 CIRCULAR          T V
2081 07 COEFFICIENT     N   V M S
2081 07 CONDITION       N   V
2081 10 CYLINDER        N T V
2081 07 DATA            N   V   S
2081 07 DIFFERENCE          V   S
2081 08 DISCONTINUOUS       V M S
2081 07 DISTRIBUTION    N       S
2081 08 DRAG                V   S
2081 09 EQUATION        N T V
2081 07 EXPERIMENTAL        V M S
2081 07 FINITE              V M S
2081 09 FLOW            N T V M S
2081 09 FLUID           N   V M S
2081 09 INTEGRATING         V M S
2081 08 KIRSCHHOFF          V M S
2081 07 MOTION          N   V   S
2081 09 NAVIER            T V M
2081 09 NUMERICAL         T V M S
2081 08 PATTERN         N   V M
2081 07 PRESSURE                S
2081 07 REDUCTION           V M
2081 09 REYNOLDS        N T V M S
2081 09 SOLUTION        N T V M S
2081 09 STEADY              V M S
2081 09 STOKES            T     S
2081 07 THEORY          N     M
2081 10 TWODIMENSIONAL      V M S
2081 08 VELOCITY            V M
2081 10 VISCOUS             V   S
2081 08 VORTICITY           V M S
2082 07 APPROXIMATION   N   V M S
2082 10 AXISYMMETRIC      T V M
2082 10 BLUNT               V M S
2082 07 BOUNDARY            V
2082 09 COEFFICIENT     N     M
2082 07 CONDITION       N     M   A
2082 07 COORDINATE      N   V M S
2082 07 CYLINDRICAL         V M S
2082 05 DIFFERENCE      N     M S
2082 09 EQUATION        N T V M
2082 07 FINITE                  S
2082 09 FLOW            N T V M S
2082 07 FUNCTION                S
2082 09 INCOMPRESSIBLE        M
2082 09 LOW               T V
2082 10 NAVIERSTOKES      T   M S
2082 10 NOSED               V M S
2082 10 NUMBER          N T
2082 09 NUMERICAL         T V   S
2082 08 ORIFICE           T V M S
2082 10 PIVOT               V M
2082 06 POINT               V   S
2082 09 PRESSURE        N   V M S
2082 10 REYNOLDS          T V
2082 08 SIZE            N T V
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2082 09 SOLUTION                     N T V M S
2082 06 STAGNATION                       V M
2082 09 STEADY                         T V
2082 08 STOKES                           V M S
2082 08 STREAM                           V
2082 06 STREAMLINE                   N       S
2082 10 TUBE                         N T V M S
2082 07 VARIABLE                     N   V   S
2082 05 VARIATION                    N   V
2082 06 VELOCITY                         V M S
2082 10 VISCOSITY                    N T     S
2082 10 VISCOUS                        T V   S
2082 08 VORTICITY                        V M S
2083 08 AIR                              V M S
2083 05 BOUNDARY                         V M S
2083 08 CHANNEL                          V   S
2083 08 CIRCULAR                         V   S
2083 05 CONDITION                    N   V M SA
2083 08 CURRENT                      N   V   S
2083 08 CYLINDER                     N   V M S
2083 07 DETERMINATION                N   V M S
2083 07 DISTRIBUTION                 N   V   S
2083 06 DRAG                         N   V M S
2083 07 EXPERIMENTAL                     V   S
2083 09 FLOW                         N T V M S
2083 06 FLUID                        N T     S
2083 06 FRICTION                         V M S
2083 05 GIVEN                            V M S
2083 05 NORMAL                           V   S
2083 07 NUMBER                       N   V   S
2083 09 NUMERICAL                        V M S
2083 08 PARALLEL                         V M S
2083 06 PERFECT                          V M S
2083 07 PRESSURE                         V   S
2083 07 REYNOLDS                         V M S
2083 06 SKIN                             V   S
2083 09 SOLUTION                     N   V M S
2083 05 SPEED                        N       S
2083 07 STATIONARY                       V   S
2083 09 STEADY                           V M S
2083 06 STREAMLINE                   N   V M S
2083 06 SURFACE                          V   S
2083 05 TOTAL                            V M S
2083 10 TWODIMENSIONAL                   V M S
2083 06 UNWIND                           V   S
2083 10 VISCOUS                          V M
2083 06 VORTICITY                    N   V M
2083 08 WALL                         N   V M S
2084 09 APPROXIMATION                N   V M S
2084 06 CHANNEL                          V   S
2084 10 CIRCULAR                       T V   S
2084 07 COEFFICIENT                  N     M S
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2084	10	CYLINDER	N	T	V		S
2084	07	DISTRIBUTION	N		V	M	S
2084	08	DRAG	N		V		S
2084	08	EDDY			V		S
2084	07	EXPERIMENT	N		V		S
2084	08	FILAMENT				M	S
2084	09	FLOW	N	T		M	
2084	07	FREQUENCY	N		V		S
2084	00	FRICTION			V		
2084	05	FUNCTION	N		V	M	S
2084	06	KARMAN			V		S
2084	07	LINE	N		V		S
2084	09	LOW		T	V	M	S
2084	08	NUMBER	N		V	M	S
2084	09	NUMERICAL			V		S
2084	07	OIL			V	M	S
2084	08	OSCILLATING			V	M	
2084	07	PHOTOGRAPHIC			V	M	S
2084	07	PRESSURE			V		S
2084	07	REGION	N		V	M	S
2084	08	REYNOLDS			V	M	
2084	08	SEPARATION	N		V	M	S
2084	08	SKIN			V		S
2084	09	SOLUTION	N		V		S
2084	09	SPEED		T	V	M	
2084	09	STEADY			V	M	S
2084	06	STREAM			V	M	S
2084	08	STREAMLINE	N		V		S
2084	06	STREET	N		V	M	S
2084	07	STUDY			V	M	S
2084	09	SUCCESSIVE			V		S
2084	07	TOTAL			V	M	S
2084	10	VISCOUS			V		S
2084	08	VORTICITY	N		V	M	S
2084	06	WALL	N		V		S
2084	07	WATER			V	M	S
2085	10	CONVERGENCE	N	T		M	S
2085	09	EQUATION	N	T	V	M	S
2085	09	FLOW	N		V	M	
2085	07	LOCAL					S
2085	08	MESH			V		S
2085	10	NAVIERSTOKES		T			
2085	09	NUMERICAL		T	V		S
2085	08	REYNOLDS	N		V		
2085	09	SOLUTION	N	T	V	M	
2085	09	STEADY			V	M	
2085	10	TWODIMENSIONAL			V	M	S
2087	05	APPROXIMATION	N		V		S
2087	08	BOUNDARY			V	M	
2087	10	CONVERGENCE		T		M	S
2087	10	DIFFERENTIAL		T	V		S
2087	06	EIGENVALVE			V		S

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2087 10 EQUATION              N T V M S
2087 05 EXTRAPOLATED              V M S
2087 10 ITERATIVE               T     S
2087 06 LIEBMAN                   V M S
2087 07 METHOD                N     M S
2087 09 NUMERICAL                 V M S
2087 10 PARTIAL                 T   M S
2087 05 PROBLEM               N   V
2087 09 RATE                  N T V M
2087 08 RELAXATION                V M S
2087 06 RICHARDSON                V M
2087 05 SECONDORDER               V
2087 09 SOLUTION              N   V M
2087 05 SUCCESSIVE                  M S
2088 07 APPROXIMATION         N       S
2088 10 BOUNDARY                      S
2088 08 CONVERGENCE               V M
2088 09 DIFFERENCE            N T V M
2088 10 DIFFERENTIAL              V M
2088 10 ELLIPTIC                T V
2088 10 EQUATION              N T   M S
2088 09 FINITE                    V M S
2088 10 ITERATIVE               T V M S
2088 06 LIEBMAN                   V
2088 07 METHOD                N T   M S
2088 09 NUMERICAL                 V M
2088 08 OVERRELAXATION                S
2088 10 PARTIAL                 T   M S
2088 09 PROBLEM               N   V M S
2088 07 RATE                  N   V M S
2088 06 RICHARDSON                V   S
2088 09 SOLUTION                  V M S
2088 07 SUCCESSIVE                  M S
2088 10 VALUE                     V M S
2099 10 ABLATION              N T V M
2099 10 ANALYSIS              N       S
2099 06 BLUNT                     V M S
2099 06 BODY                  N       S
2099 06 BOUNDARY                  V M S
2099 08 CAPACITY              N     M
2099 06 CONDITION             N   V   S
2099 06 COOLING               N   V   S
2099 08 EFFECTIVE                 V   S
2099 08 ENTHALPY              N   V   S
2099 06 FLOW                  N   V M S
2099 08 HEAT                      V   S
2099 06 LAYER                       M S
2099 10 MECHANISM             N       S
2099 10 POINT                   T
2099 10 SHIELDING                 V   S
2099 06 SOLID                 N   V M S
2099 10 STAGNATION              T V M S
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2099 08 STREAM                              V M S
2099 08 SURFACE                             V M S
2099 10 THEORETICAL                       T V M
2099 08 TRANSFER                        N       S
2099 08 VAPOURIZATION                   N   V   S
2099 06 WALL                                V M S
2100 08 ABLATING                            V   S
2100 10 ABLATION                          T V M S
2100 09 ANALYSIS                        N   V M S
2100 08 BEHIND                              V   S
2100 10 BOUNDARY                            V M S
2100 06 COMBUSTION                      N   V M S
2100 06 COMPRESSIBLE                        V M S
2100 10 COOLING                         N   V M S
2100 06 CYLINDER                        N     M S
2100 10 DERIVATION                      N     M S
2100 06 DOWNSTREAM                          V M S
2100 06 EFFECT                          N   V M S
2100 10 EFFECTIVE                           V M S
2100 08 EQUILIBRIUM                         V M S
2100 07 EXPERIMENTAL                        V   S
2100 06 FLOW                            N   V   S
2100 10 HEAT                                V   S
2100 06 HEMISPHERICAL                       V M S
2100 06 INCONEL                             V M
2100 08 LAMINAR                               M S
2100 10 LAYER                           N       S
2100 06 LOCAL                               V M S
2100 08 MATERIAL                        N       S
2100 08 NONABLATING                         V M S
2100 06 NOSEPIECE                       N   V M S
2100 09 PREDICTION                      N   V M S
2100 06 RADIATION                       N   V M S
2100 06 RATIO                               V M S
2100 10 RELATIONSHIP                    N   V   S
2100 10 RESULT                          N       S
2100 08 STAGNATION                            M S
2100 06 STREAM                              V   S
2100 06 SURFACE                             V M S
2100 08 TEFLON                              V   S
2100 06 TEMPERATURE                     N   V   S
2100 07 TEST                            N       S
2100 08 THREEDIMENSIONAL                        S
2100 10 TRANSPIRATION                       V   S
2100 06 TURBULENT                           V M S
2100 06 TWODIMENSIONAL                          S
2100 06 WALL                                V M S
2101 10 ABLATION                          T V M S
2101 06 AIR                                 V M S
2101 10 CAPACITANCE                         V M S
2101 06 CHANGE                          N   V M S
2101 10 CONTINUOUS                          V   S
2101 08 DEGREE                              V M
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2101 06 ETHYLENE                             M S
2101 06 EXPERIMENTAL                       V   S
2101 08 FAHRENHEIT                     N       S
2101 06 FLIGHT                             V M S
2101 08 HEAT                               V M S
2101 06 HEATED                               M
2101 10 VARIABLE                               S
2102 08 ALTITUDE                       N   V M S
2102 06 ATMOSPHERE                     N   V M S
2102 09 DATA                           N   V M S
2102 07 EFFECT                         N   V   S
2102 06 EXTREME                            V
2102 10 FIVESTAGE                        T   M S
2102 10 FLIGHT
2101 06 HIGH                               V   S
2101 06 JET                            N   V   S
2101 06 LENGTH                             V M S
2101 10 MEASUREMENT                    N   V M S
2101 04 PHOTOGRAPHIC                       V M S
2101 06 POLYMER                            V M S
2101 06 PROBE                              V   S
2101 10 RATE                           N T     S
2101 04 RECORD                         N   V M S
2101 10 SENSOR                         N T V M S
2101 08 SHIELD                         N   V M S
2101 06 SIMULATED                            M S
2101 08 STAGNATION                         V
2101 06 SYSTEM                         N   V   S
2101 08 TEFLON                             V M S
2101 06 TELEMETERING                       V M S
2101 06 TEMPERATURE                        V M S
2101 06 TEST                           N   V   S
2101 06 TYPE                           N     M S
2102 10 FUEL                             T   M S
2102 08 LOAD                           N   V M S
2102 06 MAXIMUM                                S
2102 06 MILES                          N   V M S
2102 06 NAUTICAL                             M S
2102 08 PAY                                V   S
2102 06 POUND                              V M S
2102 10 ROCKET                           T V   S
2102 10 SOLID                            T   M
2102 10 SOUNDING                         T V M S
2102 10 SYSTEM                         N T   M S
2102 10 TEST                               V
2102 06 TRAJECTORY                     N       S
2102 06 UPPER                              V
2102 06 VEHICLE                        N   V M S
2102 06 VELOCITY                       N   V   S
2102 08 WIND                               V M
2103 08 ALTITUDE                       N   V   S
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2103 10 ATMOSPHERE              N T V
2103 10 DENSITY                 N T V
2103 08 LATITUDE                N
2103 09 MEASUREMENT             N       S
2103 10 PRESSURE                N T V M
2103 08 PROPAGATION             N   V
2103 09 ROCKET                    T   M S
2103 08 SEASON                  N     M S
2103 08 SOUND                           S
2103 10 TEMPERATURE             N T V   S
2103 10 UPPER                     T V
2104 10 AERODYNAMIC               T V M S
2104 10 BLUNT                     T V M S
2104 08 BODY                        V M
2104 08 CONCAVE                     V M
2104 08 CURVATURE               N     M S
2104 08 CYLINDER                N   V   S
2104 09 DATA                    N   V   S
2104 08 EDGE                    N   V   S
2104 09 EXPERIMENTAL                V M S
2104 08 FACED                       V   S
2104 08 FLAT                          M S
2104 09 FLIGHT                      V M S
2104 06 FLOW                    N   V M
2104 08 HEAT                        V M S
2104 10 HEATING                 N T V   S
2104 08 HEMISPHERICAL               V   S
2104 06 LAMINAR                     V M
2104 06 LEEWARD                     V   S
2104 08 LOCAL                       V M S
2104 06 LOCATION                    V M S
2104 10 MACH                    N T     S
2104 10 NOSE                    N T V   S
2104 08 POINT                   N   V M S
2104 08 RADIUS                      V M S
2104 10 RATE                    N   V   S
2104 08 SEGMENT                 N   V   S
2104 10 SHAPE                   N T V M
2104 08 STAGNATION                      S
2104 10 TEST                    N   V M S
2104 08 TOTAL                         M S
2104 08 TRANSFER                N     M S
2104 09 TUNNEL
2104 06 TURBULENT                   V M S
2104 06 UNSTEADY                    V   S
2104 09 WIND                        V M S
2104 06 WINDWARD                      M S
2111 06 AERDELASTICITY          N   V M S
2111 06 ASPECT                      V M S
2111 06 BENDING                     V M S
2111 06 BODY                        V   S
2111 09 CALCULATION             N   V   S
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2111 06 CANTELEVER                    M
2111 06 CONCENTRATED                V M S
2111 06 DEGREE                      V M S
2111 06 DELTA                       V M S
2111 06 DIFFERENTIAL                V M S
2111 06 EQUATION                N   V   S
2111 06 FIELD                   N   V M S
2111 00 FLOW                    N   V M S
2111 10 FLUTTER                 N T V M S
2111 06 FREEDOM                 N   V M S
2111 06 FREON                           S
2111 06 FUNCTION                N   V M S
2111 06 GAS                     N   V M S
2111 10 HIGH                      T V   S
2111 06 INDICIAL                    V   S
2111 06 LIFT                        V   S
2111 06 LINEARIZED                  V   S
2111 06 MARGIN                      V M S
2111 06 MATERIAL                N   V M S
2111 06 MEDIUM                      V M S
2111 06 MODE                    N     M
2111 00 NONSTEADY                   V M S
2111 06 OSCILLATING                 V   S
2111 00 OSCILLATION             N   V   S
2111 06 PITCHING
2111 06 PRESSURE                    V   S
2111 06 PROPELLER               N   V M S
2111 06 RATIO                   N   V M S
2111 06 REFERENCE                   V   S
2111 10 RESEARCH                N T V M S
2111 06 ROCKET                      V M S
2111 06 SAFETY                  N   V   S
2111 00 SELECTED                    V M S
2111 06 SMALL                       V M S
2111 06 SONIC                       V M S
2111 10 SPEED                   N T V   S
2111 06 STALL                       V M S
2111 06 STATIC                      V   S
2111 07 SUPERSONIC                  V M S
2111 06 SWEPT                       V   S
2111 06 TEST                    N   V   S
2111 06 TESTING                 N   V M S
2111 06 THEORY                  N   V   S
2111 06 TUNNEL                      V M S
2111 06 TYPE                        V
2111 06 VARIABLE                    V   S
2111 06 VEHICLE                 N   V M S
2111 06 VERY                        V M S
2111 06 WEIGHT                  N   V   SA
2111 06 WIND                        V M S
2111 06 WING                    N   V   S
2150 10 ALTITUDE                    V M S
2150 10 ATMOSPHERIC                   M
2150 10 DENSITY                 N T V   S
2150 09 ERROR                   N
2150 10 GAUGE                       V   S
```

2150	10	IONIZATION					S
2150	09	MEASUREMENT	N	T		M	
2150	09	MOUNTED			V	M	S
2150	09	RESULT	N	T	V	M	
2150	10	SATELLITE	N	T			S
2150	09	SINGLY				M	S
2153	08	AEROFOIL	N			M	S
2153	08	ARC					S
2153	09	AXISYMMETRIC			V	M	S
2153	08	BODY	N		V		S
2153	10	CHOKED		T	V		
2153	08	CIRCULAR			V	M	S
2153	08	CONE				M	S
2153	08	CYLINDER	N		V		S
2153	08	DIMENSION	N		V	M	S
2153	07	DISTRIBUTION	N		V	M	S
2153	08	DOUBLE			V	M	S
2153	07	EFFECT	N		V	M	S
2153	09	FLOW	N	T	V		S
2153	09	FREE		T		M	S
2153	08	INTERFERENCE	N		V	M	
2153	10	MACH	N	T	V		S
2153	08	MODEL			V	M	S
2153	08	NACA			V	M	S
2153	08	PARABOLIC			V	M	
2153	07	PRESSURE			V	M	S
2153	08	REFLECTION			V		S
2153	07	RESULT	N		V		S
2153	09	SIMULATION	N	T	V		
2153	09	SOLID			V		S
2153	09	STREAM		T	V		S
2153	07	TEST	N				S
2153	07	THEORY	N		V	M	S
2153	10	TRANSONIC			V	M	S
2153	10	TUNNEL	N	T	V	M	S
2153	09	TWODIMENSIONAL			V		
2153	09	UNBOUNDED			V		
2153	09	WALL			V	M	
2153	08	WAVE			V	M	S
2153	08	WEDGE			V	M	
2153	10	WIND		T	V	M	S
2154	08	ANGLE			V	M	S
2154	08	ARTIFICIAL			V	M	S
2154	08	ATTACK			V	M	
2154	08	BLOCKAGE			V	M	
2154	10	BOUNDARY		T	V	M	
2154	05	CHANGE					S
2154	08	CHOKING	N		V	M	S
2154	06	CONDITION	N		V	M	S
2154	08	CORRECTION	N		V	M	S
2154	06	CROSSFLOW				M	S
2154	06	DENSITY			V		S

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2154 05 FLOW                     N   V   S
2154 05 INDUCED                        M S
2154 10 INTERFERENCE             N   V   S
2154 10 LAYER                    N T V   S
2154 06 MASS                             S
2154 05 NORMAL                       V   S
2154 09 PERTURBATION                 V M
2154 10 SECTION                    T V   S
2154 06 SHEAR                        V M
2154 06 SLOPE                    N   V M S
2154 09 SMALL                        V M S
2154 06 STREAMLINE                   V   S
2154 10 TEST                       T V M S
2154 09 THEORY                   N     M S
2154 08 THICKENING                   V M S
2154 10 TRANSONIC                  T   M S
2154 10 TUNNEL                   N     M
2154 10 WALL                     N T   M S
2154 10 WIND                             S
2155 06 BODY                           M S
2155 10 BOUNDARY                   T   M S
2155 08 CHOKING                      V M S
2155 09 DISTRIBUTION             N   V   S
2155 09 DRAG                     N   V M S
2155 09 FLOW                     N   V
2155 09 HIGH                       T V M
2155 10 INTERFERENCE             N   V
2155 10 LAYER                    N T V
2155 07 MACH                           M S
2155 09 MEASUREMENT              N T V M S
2155 10 MODEL                    N
2155 07 NUMBER                   N     M S
2155 09 PRESSURE                         S
2155 06 REVOLUTION               N   V   S
2155 09 SUBSONIC                   T V   S
2155 10 THICKENING                   V   S
2155 10 TUNNEL                     T V   S
2155 06 TWODIMENSIONAL                 M S
2155 10 WALL                       T   M
2155 10 WIND                       T V M
2155 06 WING                     N   V M
2157 08 AIR                      N   V   S
2157 06 BALLISTIC                    V M S
2157 08 BLUNT                        V M S
2157 08 BODY                     N   V   S
2157 07 BOUNDARY                     V
2157 09 DESIGN                   N   V   S
2157 08 DETACHED                     V   S
2157 08 DETACHMENT                   V   S
2157 08 DISTANCE                 N   V M S
2157 08 DISTRIBUTION             N   V M S
2157 08 DRIVEN                       V   S
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2157 08 EDGE                  N   V   S
2157 07 EQUILIBRIUM               V M S
2157 08 EXCESS                    V   S
2157 08 FLAT                      V   S
2157 06 FLIGHT                      M S
2157 07 FLOW                  N   V M S
2157 05 FLUID                     V M S
2157 08 HELIUM                N   V M S
2157 08 HEMISPHERE            N   V M S
2157 07 HIGH                      V   S
2157 08 HYDROGEN                  V M S
2157 10 HYPERSONIC              T V M S
2157 08 IGNITED                   V M S
2157 08 INTERACTION           N   V   S
2157 07 LAYER                     V M S
2157 08 LEADING                   V   S
2157 05 LONG                      V   S
2157 06 MACH                  N   V   S
2157 05 MECHANICS             N       S
2157 06 MISSILE               N   V M S
2157 08 MIXTURE                   V M S
2157 08 NOZZLE                N   V   S
2157 08 OXYGEN                    V M
2157 08 PLATE                 N   V M S
2157 08 PRESSURE                  V
2157 05 RANGE                     V   S
2157 06 SATELLITE             N   V M S
2157 10 SHOCK                   T V M S
2157 08 STAGNATION                V   S
2157 08 STOICHIOMETRIC            V   S
2157 08 STRONG                    V M S
2157 08 SURFACE                   V M S
2157 07 TEMPERATURE           N   V M S
2157 07 TEST                  N   V M S
2157 08 TUBE                  N   V M S
2157 10 TUNNEL                N T V M S
2157 07 TWODIMENSIONAL            V   S
2157 08 VELOCITY              N   V M S
2157 08 WAVE                  N     M S
2187 08 ANALYTICAL                    S
2187 08 ASSOCIATED                    S
2187 10 BOUNDARY                T   M S
2187 06 DATA                  N   V M S
2187 06 EXPERIMENTAL              V
2187 08 FLOW                      V   S
2187 10 INDUCED                 T
2187 10 LAYER                   T V   S
2187 08 MACH                        M S
2187 08 NOZZLE                    V M   A
2187 10 NOZZLE                N T V M
2187 10 OVEREXPANDED            T V M S
2187 08 POINT                 N   V M S
2187 09 PREDICTION            N     M S
2187 10 PRESSURE                  V M S
2187 08 RATIO                 N   V M S
2187 08 REGIME                N     M
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2187 10 SEPARATION          N T V M
2187 10 RISE                    V M S
2187 10 SHOCK                 T
2187 08 SIMPLE                    M S
2187 08 SOLUTION            N   V M S
2187 08 STREAM                  V   S
2187 10 SUPERSONIC                M S
2274 08 AIR                 N   V   S
2274 08 ALTITUDE                V
2274 08 ANGLE               N     M S
2274 10 BLUNT                 T     S
2274 10 BODY                N T   M S
2274 07 BOUNDARY                V M S
2274 07 CONDITION           N   V M S
2274 08 CONE                    V M S
2274 07 DEGREE                  V M S
2274 07 DENSITY                 V M S
2274 08 DETACHMENT              V   S
2274 08 DISTANCE            N   V M S
2274 07 DISTRIBUTION        N   V M S
2274 09 EFFECT              N T   M S
2274 08 EQUILIBRIUM         N   V
2274 08 EXPANSION               V   S
2274 09 EXPERIMENT          N   V   S
2274 07 FLAT                    V M S
2274 09 FLOW                N T V M S
2274 08 FROZEN                  V   S
2274 10 GAS                   T V M S
2274 08 HEATED                  V M S
2274 08 HEMISPHERE          N   V M S
2274 07 HIGH                    V   S
2274 09 HYPERSONIC            T
2274 08 INTERACTION         N   V   S
2274 07 LAMINAR                 V M S
2274 07 LAYER                   V   S
2274 08 LOCATION                V M S
2274 07 LOW                     V M S
2274 08 LUMINOUS                V   S
2274 07 MACH                N   V   S
2274 08 NOZZLE                  V M S
2274 07 PHOTOGRAPH          N   V   S
2274 07 PLATE               N   V M S
2274 08 POINT               N   V M
2274 07 PRESSURE            N   V
2274 08 PROFILE             N   V   S
2274 08 RAREFIED                V M S
2274 10 REAL                  T V M S
2274 07 REGION              N   V   S
2274 08 SHAPE               N   V M S
2274 10 SHOCK                   V M S
2274 07 SIMULATION              V   S
2274 08 SONIC                   V   S
2274 08 STAGNATION              V   S
2274 08 STATIC                  V M
2274 07 TEMPERATURE         N   V M
2274 08 THERMAL                 V M S
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2274 08 THICKNESS           N   V   S
2274 09 TUNNEL              N   V M S
2274 07 TWODIMENSIONAL          V M S
2274 08 WAVE                    V M S
2274 08 WEDGE                   V   S
2313 08 AIR                 N   V M S
2313 06 ATTENUATION             V M S
2313 06 BOUNDARY                V M S
2313 08 CONTACT                 V M S
2313 06 CROSS                   V M S
2313 07 DATA                N   V M S
2313 06 DIAPHRAGM           N   V M S
2313 08 DISTURBANCE             V   S
2313 08 DRIVING                 V M S
2313 08 DURATION            N   V M S
2313 08 END                     V M S
2313 08 ENTRY               N   V M S
2313 08 EXPANSION               V   S
2313 07 EXPERIMENTAL            V M S
2313 08 FALL                    V   S
2313 09 FLOW                  T V M
2313 06 GAS                     V   S
2313 06 GRADIENT            N   V M S
2313 08 HEAD                    V   S
2313 06 HIGH                    V M S
2313 08 HYDROGEN                    S
2313 08 INTERACTION             V M S
2313 06 LAYER                   V   S
2313 06 LOW                     V M S
2313 08 MACH                N   V M S
2313 06 MAIN                    V M S
2313 06 MEASUREMENT         N   V   S
2313 08 NOZZLE                  V M
2313 08 ORIGINATING               M S
2313 06 PERFECT                 V M S
2313 09 PERFORMANCE         N   V M
2313 08 PHOTOMULTIPLIER         V   S
2313 07 PREDICTION          N   V   S
2313 08 PRESSURE                V M S
2313 08 PRIMARY                 V M S
2313 08 RANGE                   V M S
2313 10 REFLECTED             T     S
2313 10 REFLECTION              V M S
2313 06 REYNOLDS            N   V M S
2313 08 RUNNING                 V M S
2313 06 SECTIONAL               V   S
2313 06 SHAPE                   V M S
2313 10 SHOCK               N T V M S
2313 06 SIZE                    V M S
2313 06 STRAIGHT                  M S
2313 08 SURFACE             N   V M S
2313 08 TAIL                    V M S
2313 07 THEORETICAL             V M
2313 06 THEORY              N   V   S
2313 06 THROUGH                 V   S
2313 08 TIME                    V M SA
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2313	08	TUBE	N		V		S
2313	10	TUNNEL	N	T	V	M	S
2313	08	UNHEATED			V	M	S
2313	08	UNIFORM			V	M	S
2313	06	UPSTREAM			V	M	S
2313	06	WALL			V	M	S
2313	08	WAVE			V		S
2316	06	ARC	N		V	M	S
2316	08	ARGON			V		S
2316	10	BEAM	N	T	V	M	S
2316	06	CARBON			V	M	S
2316	08	CHLORIDE			V		
2316	08	DISEQUILIBRIUM	N			M	S
2316	09	DOUBLE		T	V		S
2316	08	EXCITATION	N		V	M	
2316	08	FILTER	N		V	M	SA
2316	08	FRONT	N		V	M	S
2316	07	HYPERSONIC			V		S
2316	08	INTERFERENCE			V		S
2316	08	IODIDE	N		V		S
2316	10	LIGHT					S
2316	10	LINE		T	V	M	
2316	09	MEASUREMENT	N	T	V		S
2316	08	NITROGEN			V		S
2316	08	OSCILLOGRAPH	N		V	M	
2316	08	OXYGEN				M	S
2316	08	RADIATIVE					
2316	08	RELAXATION				M	S
2316	10	REVERSAL	N	T	V		
2316	08	SALT	N			M	S
2316	10	SHOCK		T		M	
2316	06	SINGLE			V	M	S
2316	08	SODIUM			V		
2316	10	SPECTRUM		T	V	M	S
2316	10	TEMPERATURE		T		M	S
2316	08	TUBE	N		V	M	
2316	10	WAVE	N	T	V		S
2317	08	ACTUAL			V	M	
2317	09	ANALYSIS	N		V		S
2317	10	ATTENUATION			V	M	S
2317	08	BEHIND			V	M	S
2317	08	BOUNDARY				M	
2317	06	CONSERVATION				M	S
2317	08	CONSTANT			V	M	S
2317	08	DIAMETER					S
2317	06	EQUATION	N		V	M	S
2317	08	EXPERIMENTAL			V		S
2317	08	FLOW			V	M	S
2317	08	GAS				M	S
2317	08	IDEAL			V		S
2317	08	INITIATED			V	M	
2317	08	INTERFACE	N		V	M	S

2317	08	LAYER			V		S
2317	08	LENGTH				M	S
2317	08	LOSS			V		S
2317	06	MASS			V		S
2317	08	REAL			V	M	S
2317	10	SHOCK	N	T	V	M	S
2317	08	STRONG			V	M	S
2317	08	TEST			V	M	S
2317	10	TESTING		T	V	M	S
2317	09	THEORETICAL				M	S
2317	10	TIME	N	T	V	M	S
2317	10	TUBE	N	T	V	M	
2317	10	WAVE	N		V	M	S
2318	09	BLUNT				M	S
2318	09	BODY	N		V	M	S
2318	09	BOW			V	M	S
2318	08	BURSTING					
2318	08	DAMPING			V	M	S
2318	06	FLAME			V	M	
2318	09	FLOW	N			M	S
2318	10	GUN		T	V	M	S
2318	10	HYPERSONIC		T	V	M	
2318	10	LINE		T	V		S
2318	09	MEASUREMENT	N	T	V		
2318	09	METHOD	N	T	V	M	
2318	08	PISTON	N		V	M	
2318	08	PLATE	N		V	M	S
2318	08	PRESSURE			V	M	S
2318	07	RATIO	N		V		S
2318	07	REMOVAL					
2318	08	RESERVOIR					S
2318	10	REVERSAL		T		M	S
2318	09	SHOCK					
2318	10	SODIUM		T	V	M	S
2318	10	STAGNATION		T	V		S
2318	10	TEMPERATURE	N	T			S
2318	10	TUNNEL	N	T	V		
2318	09	WAVE	N		V	M	
2319	10	BLUNT		T	V		S
2319	10	BODY	N	T	V	M	S
2319	06	BOUNDARY			V		S
2319	07	CONDITION	N				S
2319	08	CONE			V	M	S
2319	06	DENSITY			V	M	S
2319	06	DETACHED			V	M	S
2319	08	DETACHMENT					S
2319	08	DISTANCE	N		V	M	
2319	08	DISTRIBUTION	N		V	M	S
2319	09	EFFECT	N	T	V	M	S
2319	06	EQUILIBRIUM	N		V		S
2319	06	EXPANSION	N				S
2319	06	FLAT			V	M	

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2319 09 FLOW                     N T V M S
2319 06 FROZEN                       V   S
2319 10 GAS                        T V M S
2319 06 HEAT                         V M S
2319 08 HEMISPHERE               N   V   S
2319 09 HYPERSONIC                 T     S
2319 06 INTERACTION              N   V M S
2319 06 LAYER                    N     M S
2319 08 LOCATION                 N   V M S
2319 05 LOW                          V M S
2319 06 LUMINOSITY               N   V M
2319 06 MACH                         V   S
2319 05 MODIFIED                     V   S
2319 06 NEWTONIAN                    V M S
2319 08 NOZZLE                   N   V M S
2319 06 PLANETARY                    V   S
2319 06 PLATE                        V M S
2319 08 POINT                        V
2319 08 PRESSURE                 N   V M S
2319 10 REAL                       T V M S
2319 06 REENTRY                  N   V   S
2319 08 SHAPE                    N   V   S
2319 10 SHOCK                        V   S
2319 08 SONIC                        V   S
2319 06 SPACE                        V   S
2319 08 STAGNATION                   V M
2319 08 STATIC                       V M S
2319 07 TEMPERATURE              N     M S
2319 09 TEST                     N   V   S
2319 05 THEORY                   N   V M
2319 06 THERMAL                      V   S
2319 06 TRANSFER                 N   V M S
2319 08 TUBE                         V   S
2319 10 TUNNEL                       V M
2319 06 TWODIMENSIONAL               V M S
2319 06 VEHICLE                  N   V M S
2319 08 WAVE                         V   S
2321 06 BODY                     N   V   S
2321 10 BOUNDARY                 N T V M S
2321 05 COEFFICIENT              N   V M S
2321 06 DAMPING                  N   V M S
2321 06 DEFLECTION               N
2321 08 DISSIPATIVE                  V M S
2321 06 DISTRIBUTION             N   V   S
2321 08 DISTURBANCE              N   V M S
2321 06 DRAG                         V   S
2321 08 FLEXIBILITY              N   V M S
2321 10 FLEXIBLE                   T V   S
2321 08 HELMHOLTZ                    V M S
2321 10 HYDRODYNAMIC             N T V M S
2321 08 INSTABILITY              N   V M S
2321 06 INTERNAL                     V   S
2321 08 KELVIN                       V M S
2321 07 LAYER                        V M S
2321 06 MATERIAL                     V   S
2321 08 NONDISSIPATIVE                   S
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2321 06 PRESSURE                      V
2321 05 REDUCTION             N             S
2321 06 RESPONSE                      V  M
2321 08 SCHLICHTING                   V  M  S
2321 06 SINUSOIDAL                    V     S
2321 08 SKIN                          V  M  S
2321 07 SMALL                         V     S
2321 06 SOLID                            M  S
2321 10 STABILITY             N   T   V  M  S
2321 06 STIFFNESS             N       V  M  S
2321 08 SURFACE               N       V     S
2321 07 THEORY                N       V     S
2321 08 TOLLMIEN                      V     S
2321 06 TRAVELLING                    V  M  S
2321 06 UNDERWATER            N       V
2321 08 WAVE                  N       V     S
2322 09 ANALYTIC                      V  M
2322 09 APPROXIMATE                   V
2322 08 ATTACHED                      V  M  S
2322 09 BOUNDARY              N   T      M  S
2322 08 COMPRESSION                   V  M  S
2322 07 CONSTANT                      V     S
2322 08 DENSITY                       V  M  S
2322 08 DISPLACEMENT                  V     S
2322 10 ELASTIC                       V     S
2322 09 EQUATION              N   T   V  M  S
2322 07 EXPOSED                          M  S
2322 07 FAST                                S
2322 08 FIXED                         V  M  S
2322 10 FLAT                          V  M  S
2322 10 FLEXIBLE                  T   V  M
2322 08 FLEXURAL                      V  M  S
2322 08 FLUID                 N       V
2322 07 FREE                          V     S
2322 07 HEAVY                         V     S
2322 10 HOMOGENEOUS                   V  M  S
2322 09 INCOMPRESSIBLE                      S
2322 07 INNER                         V  M  S
2322 07 INTERIOR                      V     S
2322 10 ISOTROPIC                        M  S
2322 09 LAMINAR                          M  S
2322 09 LAYER                 N   T   V  M  S
2322 07 LIGHT                         V  M  S
2322 08 LONGITUDINAL                  V
2322 07 MATERIAL              N          M  S
2322 10 MODE                  N       V  M  S
2322 08 NEUTRAL                       V     S
2322 10 NONDISSIPATING                V  M  S
2322 10 OSCILLATION           N       V  M
2322 10 PLATE                         V     S
2322 08 PROPAGATING                      M
2322 07 RATIO                            M  S
2322 08 RAYLEIGH                         M  S
2322 08 RESONANCE             N       V  M  S
2322 08 RIGIDLY                       V  M  S
2322 08 SHEAR                         V  M  S
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2322	08	SHEET			V	M	S
2322	07	SLOWLY				M	S
2322	08	SOLID	N		V	M	S
2322	09	SOLUTION	N	T	V	M	S
2322	10	STABILITY	N	T	V	M	S
2322	08	STRESS	N		V	M	S
2322	08	STRUCTURE	N		V	M	S
2322	10	SURFACE	N	T	V	M	S
2322	08	THICKNESS			V	M	S
2322	08	TOLLMIENSCHLICHTING			V		S
2322	07	UNIFORM			V	M	S
2322	08	VISCOUS			V	M	S
2322	08	WAVE	N		V		S
2338	10	CENTRE		T	V	M	S
2338	09	DEGREE		T		M	
2338	09	FLOW	N		V	M	S
2338	10	FLUTTER	N	T	V	M	
2338	10	GRAVITY		T	V	M	S
2338	10	LOCATION	N	T	V		S
2338	08	MACH			V	M	
2338	09	NACA			V		
2338	00	NUMBER	N				
2338	07	RATIO	N		V	M	S
2338	09	SECTION	N			M	S
2338	08	SPEED			V	M	
2338	06	SUPERSONIC			V	M	S
2338	10	SWEPTBACK		T			S
2338	09	TEST	N		V	M	
2338	10	TRANSONIC		T			S
2338	09	TUNNEL			V		
2338	09	WIND					S
2338	10	WING	N	T			S
2339	07	AERODYNAMIC			V		S
2339	09	ANALYSIS	N	T	V	M	S
2339	08	ANGLE	N		V		
2339	06	ASPECT				M	S
2339	05	ATTACK			V		S
2339	00	CALCULATION	N	T	V	M	
2339	06	CENTRE	N		V		S
2339	06	CIRCULATION			V		S
2339	07	CURVE			V	M	S
2339	07	DISTRIBUTION	N		V		S
2339	09	FINITE		T	V		
2339	09	FLOW	N		V	M	S
2339	10	FLUTTER	N	T	V	M	S
2339	08	FREQUENCY	N		V		S
2339	06	FUNCTION	N		V		S
2339	06	GRAVITY			V		S
2339	07	LIFT	N		V		S
2339	07	LOADING	N			M	
2339	07	LOCAL				M	S
2339	06	LOCATION	N		V		S

2339	07	MACH	N			M	S
2339	06	MAGNITUDE	N			M	S
2339	08	MODAL			V	M	S
2339	06	MODE	N		V	M	
2339	09	MODIFIED		T	V		S
2339	06	MOMENT	N		V	M	S
2339	06	MOTION	N			M	S
2339	06	OSCILLATORY			V	M	S
2339	06	PHASE			V		S
2339	06	PITCHING			V		S
2339	05	RATIO	N		V	M	
2339	10	RAYLEIGH			V	M	
2339	07	SECTION			V		
2339	07	SLOPE	N		V	M	S
2339	09	SPAN		T	V	M	
2339	08	SPEED	N	T	V		S
2339	07	STEADY			V	M	
2339	10	STRIP		T	V	M	S
2339	09	SUBSONIC		T	V		S
2339	09	SUPERSONIC		T	V	M	S
2339	08	SWEEP			V		
2339	10	SWEPT		T	V		S
2339	06	TAPER			V	M	S
2339	07	THEORY	N		V	M	S
2339	07	THREEDIMENSIONAL			V	M	S
2339	09	TYPE			V	M	S
2339	06	UNCOUPLED			V	M	
2339	10	UNSWEPT		T	V		
2339	06	VECTOR	N		V		S
2339	06	VIBRATION			V	M	S
2339	10	WING	N	T	V		S
2340	08	AMOUNT			V	M	S
2340	10	BENDING			V	M	S
2340	10	CONSTRUCTION	N	T	V		S
2340	10	CONTROLLING	N	T			S
2340	08	CROSS			V	M	S
2340	08	DIAMETER				M	S
2340	10	DRILLED	N		V	M	S
2340	10	DRILLING	N		V		S
2340	09	EXPERIMENT	N				
2340	00	EXPERIMENTAL					S
2340	08	FILLING			V	M	S
2340	10	HOLE					S
2340	07	MATERIAL	N		V	M	S
2340	10	MODEL		T	V		S
2340	08	PATTERN	N		V		S
2340	08	PERCENTAGE			V	M	
2340	10	PERFORATED			V		S
2340	10	PLATES					S
2340	07	RATIO	N			M	S
2340	08	REMOVED	N		V	M	S
2340	09	RESULT	N		V	M	
2340	08	SECTION	N		V	M	S
2340	08	SOFT				M	S

```
2340 10 SOLID                                 T V M S
2340 06 SPANWISE                                  M
2340 07 SPECIMEN                            N   V M
2340 08 SQUARE                                      S
2340 06 STAGGERED                               V M S
2340 10 STIFFNESS                           N T V   S
2340 09 TEST                                        S
2340 08 THICKNESS                           N       S
2340 10 TORSIONAL                                 M S
2340 10 WEAKENING                           N   V M
2340 10 WING                                  T     S
2341 08 ANGLE                                   V   S
2341 08 ASPECT                                    M S
2341 06 BALSA                                   V   S
2341 06 COMPREG                                 V M S
2341 09 FLOW                                N   V M S
2341 10 FLUTTER                               T V M S
2341 07 INCOMPRESSIBLE                            M S
2341 08 MACH                                N   V M S
2341 06 MAGNESIUM                                 M S
2341 06 MODEL                               N   V   S
2341 06 PINE                                      M S
2341 08 PLANFORM                            N T V   S
2341 07 PREDICTION                          N   V M S
2341 08 RATIO                               N   V   S
2341 10 SPEED                               N T V   S
2341 08 SWEEPBACK                           N   V M S
2341 10 SWEPTBACK                               V M S
2341 09 TEST                                N   V M S
2341 07 THEORY                                    M
2341 10 TRANSONIC                             T V M
2341 09 TUNNEL                                  V
2341 07 TWODIMENSIONAL                          V   S
2341 09 WIND                                    V   S
2341 10 WING                                N T V M
2341 06 WOOD                                    V
2342 09 AERODYNAMIC                           T V   S
2342 10 ARBITRARY                               V   S
2342 06 ASPECT                                  V   S
2342 06 AXIS                                    V   S
2342 09 CALCULATION                         N T V M S
2342 06 CENTRE                                  V M S
2342 06 CHORDWISE                                 M S
2342 06 COEFFICIENT                         N   V   S
2342 08 CONTINUOUS                              V M S
2342 05 DERIVATIVE                          N     M S
2342 08 DOWNWASH                            N   V
2342 08 DUE
2342 06 ELLIPTIC                                V M S
2342 06 FLOW                                N   V M S
2342 08 FORMULA                                 V M
2342 08 GENERAL                                 V M S
2342 08 HORSESHOE                               V   S
2342 08 INDIVIDUAL                              V M S
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2342 06 LIFT                            V M S
2342 10 LOAD                        N   V   S
2342 08 LOADING                     N T   M S
2342 06 MAJOR                           V M S
2342 09 METHOD                      N   V M S
2342 06 MINOR                           V M S
2342 06 MOMENT                          V   S
2342 06 NOLIFT                          V M S
2342 08 PATTERN                         V M S
2342 06 PERCENT                         V M S
2342 08 PIVOTAL                         V M S
2342 08 POINT                       N
2342 08 POTENTIAL                       V   S
2342 06 PRESSURE                    N   V M S
2342 06 RATIO                       N   V M S
2342 06 RECTANGULAR                     V M S
2342 05 ROTARY                          V M S
2342 09 ROUTINE                         V M S
2342 10 SHAPE                       N T V M S
2342 06 SLOPE                           V M S
2342 10 SURFACE                       T V M S
2342 06 SYMMETRICAL                     V M S
2342 08 THEORY                      N   V M S
2342 08 THIN                            V
2342 08 TOTAL                           V   S
2342 06 TWODIMENSIONAL                  V M S
2342 08 VORTEX                      N   V M S
2342 10 WING                            V M S
2342 06 YAW                         N   V   S
2364 07 AHEAD                             M S
2364 06 ANGLE                               S
2364 09 BOUNDARY                      T V   S
2364 06 DEFLECTION                      V   S
2364 07 DISTRIBUTION                N   V M S
2364 09 EXTERNALLY                      V   S
2364 10 FLAT                            V   S
2364 09 FLOW                        N     M S
2364 07 FREE                            V M S
2364 09 GENERATED                       V M S
2364 10 INTERACTION                 N T V M S
2364 09 INTERNALLY                      V   S
2364 06 KINK                            V M S
2364 07 LAMINAR                         V M
2364 09 LAYER                       N T V M S
2364 08 MACH                            V   S
2364 07 NUMBER                      N   V M S
2364 07 PATTERN                     N   V
2364 10 PLATE                       N   V M S
2364 07 POSITION                    N   V M S
2364 08 PRESSURE                    N   V M S
2364 06 REATTACHMENT                N   V M
2364 08 REYNOLDS                        V M
2364 08 SEPARATION                      V M S
2364 10 SHOCK                         T     S
2364 07 STREAM                          V
2364 08 STRENGTH                    N   V   S
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2364 09 SUPERSONIC                        V M S
2364 09 TEST                          N   V   S
2364 08 TRANSITION                        V M S
2364 09 TUNNEL                                S
2364 07 TURBULENT                         V   S
2364 10 WAVE                          N T   M S
2364 10 WEDGE                             V M S
2364 10 WEDGE                         N     M S
2364 09 WIND                              V M S
2367 09 BOUNDARY                          V
2367 08 CURVATURE                     N T V
2367 07 DISTRIBUTION                  N   V M
2367 09 EXTENSION                         V M S
2367 09 FLOW                          N T V M S
2367 09 INVESTIGATION                 N T V M S
2367 09 LAMINAR                         T V M S
2367 09 LAYER                             V M
2367 07 MACH                            T V M
2367 09 METHOD                        N   V   S
2367 07 NUMBER                        N T V
2367 07 PRESSURE                          V M
2367 07 REYNOLDS                        T V M S
2367 10 SEPARATION                    N T V   S
2367 06 SHOCK                               M S
2367 09 STRATFORD                         V M
2367 09 SUPERSONIC                      T V
2367 08 SURFACE                         T V
2367 08 TEMPERATURE                   N T V
2367 09 THEORETICAL                     T V M
2367 05 UPSTREAM                          V M
2367 08 WALL                            T V   S
2367 06 WAVE                          N   V M S
2379 06 ACCELERATION                  N   V   S
2379 07 AERODYNAMIC                       V   S
2379 06 AIR                               V M S
2379 08 ALTITUDE                      N   V
2379 08 ANGLE                         N   V M
2379 08 ATMOSPHERIC                       V   S
2379 08 BALLISTIC                         V M S
2379 06 BREATHING                         V   S
2379 06 DECELERATION                  N   V   S
2379 08 DRAG                              V   S
2379 09 FLIGHT                        N T V M S
2379 08 GLIDE                             V M S
2379 08 HEATING                       N   V M S
2379 09 HYPERSONIC                      T V M S
2379 08 LIFT                              V   S
2379 08 LOAD                          N   V M S
2379 06 MOTION                        N   V M S
2379 06 OSCILLATORY                       V M S
2379 08 PATH                              V M S
2379 05 PERFORMANCE                   N   V   S
```

2379	06	PROPELLED			V	M	S
2379	10	PROPULSION			V	M	S
2379	07	RATIO	N		V		S
2379	08	REENTRY	N	T			
2379	10	ROCKET			V	M	S
2379	08	SKIP			V		S
2379	08	STABILITY	N		V		S
2379	05	SUPERSONIC			V		S
2379	09	SYSTEM	N		V	M	S
2379	08	TRAJECTORY	N		V		S
2379	08	VEHICLE	N			M	S
2379	08	WEIGHT			V	M	S
2391	07	AERODYNAMIC			V	M	S
2391	08	ALTITUDE	N		V	M	S
2391	09	ANALYSIS	N				S
2391	10	ATMOSPHERE	N		V		S
2391	10	BLUNT			V	M	S
2391	10	BODY	N		V	M	S
2391	07	CHARACTERISTIC	N			M	S
2391	07	COEFFICIENT	N		V	M	S
2391	08	COLLISION				M	S
2391	10	CONTINUUM			V	M	S
2391	10	COOLED			V		S
2391	06	COUETTE					S
2391	08	DENSITY					S
2391	09	DEVELOPMENT	N	T	V	M	S
2391	07	DISTRIBUTION	N		V		S
2391	08	DRAG					S
2391	08	EMITTED			V	M	S
2391	07	EQUATION			V		S
2391	09	FIELD	N	T			S
2391	07	FIRST			V	M	S
2391	09	FLOW	N	T	V		S
2391	08	FREE			V	M	S
2391	08	GAS			V	M	
2391	08	GEOMETRY	N		V	M	S
2391	08	HEAT			V		S
2391	09	HIGHLY				M	S
2391	09	HYPERSONIC		T	V		S
2391	08	INCIPIENT			V	M	S
2391	08	KINETIC			V	M	S
2391	08	LAYER			V		S
2391	07	LOCAL			V		S
2391	08	LOCATION	N		V	M	S
2391	07	MEAN			V		S
2391	08	MERGED			V		S
2391	08	MOLECULAR			V	M	S
2391	08	MOLECULE					S
2391	08	NAVIER			V	M	S
2391	10	NOSE			V	M	S
2391	07	PATH	N		V	M	S
2391	10	PLANETARY			V	M	S
2391	08	POINT			V	M	S
2391	06	PROFILE	N		V	M	S
2391	08	RAREFIED			V	M	S
2391	10	REENTRY		T		M	

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2391 08 REGIME                          N   V M S
2391 10 REGION                          N   V M S
2391 08 SHEAR                               V M S
2391 10 SHOCK                               V M S
2391 07 SLIP                            N       S
2391 07 SOLUTION                        N   V
2391 07 SPEED                           N   V M S
2391 10 STAGNATION                          V   S
2391 08 STOKES                              V M
2391 08 STRESS                          N   V M S
2391 08 SURFACE                             V M S
2391 09 THEORETICAL                         V   S
2391 07 THEORY                              V M S
2391 08 THICKNESS                       N   V M
2391 08 TRANSFER                        N   V M S
2391 08 TRANSITIONAL                          M S
2391 06 VELOCITY                            V M S
2391 08 VISCOUS                             V M
2391 10 WAVE                              T V   S
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APPENDIX C

QUESTION INDEXING

Question 79 What are the details of the rigourous kinetic theory of gases (Chapman-Enskog Theory)?

Index terms: Chapman Enskog gas kinetic theory

Question 100 How much is known about boundary layer flows along noncircular cylinders?

Index terms: boundary cylinder flow layer noncircular about

Question 116 How significant is the possible pressure of a dissociated free stream with respect to the realization of hypersonic simulation in high enthalpy wind tunnels?

Index terms: dissociated enthalpy free high hypersonic pressure simulation stream tunnel wind

Question 118 Do the discrepancies among current analyses of the vorticity effect on stagnation-point heat transfer result primarily from the differences in the viscosity-temperature law assumed?

Index terms: analysis assumed current difference effect heat law point result stagnation temperature transfer viscosity vorticity

Question 119 How far can one trust the linear viscosity temperature solution assumed in some of the analyses of hypersonic shock layer at low Reynolds number?

Index terms: analysis assumed far hypersonic layer linear low number one Reynolds shock solution temperature viscosity

Question 121 Has anyone explained the kink in the surge line of a multistage axial?

Index terms: axial compressor line multistage surge kink

Question 122 Have any aerodynamic derivatives been measured at hypersonic Mach numbers and comparison been made with theoretical work?

Index terms: comparison derivative hypersonic Mach measured number theoretical work

Question 123 Are the methods of measuring aerodynamic derivatives which could be adopted for use in short running time facilities?

Index terms: aerodynamic derivative facility measuring method running short time use

Question 126 What are wind-tunnel corrections for a two-dimensional aerofoil mounted off-center in a tunnel?

Index terms: aerofoil correction mounted tunnel twodimensional wind

Question 139 What is the present state of the theory of quasi-conical flows?

Index terms: flow quasiconical state theory

Question 132 What parameters can seriously influence natural transition from laminar to turbulent flow on a model in a wind tunnel?

Index terms: flow influence laminar model natural parameter transition tunnel turbulent wind

Question 136 How does a satellite orbit contract under the action of air drag in an atmosphere in which the scale height varies with altitude?

Index terms: action air altitude atmosphere drag height orbit satellite scale under

Question 137 How is the flow at transonic speeds about a delta wing different from that on a closely-related tapered sweptback wing?

Index terms: closely delta different flow speed sweptback transonic wing tapered

Question 141 Can methane-air combustion product be used as a hypersonic test medium and predict, within experimental accuracies, the results obtained in air?

Index terms: accuracy air combustion
experimental hypersonic medium
methane product result test

Question 145 Has anyone investigated the unsteady lift distributions on finite wings in subsonic flow?

Index terms: distribution finite flow
lift subsonic unsteady wing

Question 146 What information is available for dynamic response of airplanes to gusts or blasts in the subsonic regime?

Index terms: aeroplane blast dynamic gust
regime response subsonic

Question 147 Will forward or apex located controls be effective at low subsonic speeds and how do they compare with conventional trailing-edge flaps?

Index terms: apex control conventional edge
effective flap forward located
low speed subsonic trailing

Question 148 Given that an uncontrolled vehicle will tumble as it enters an atmosphere, is it possible to predict when and how it will stop tumbling and its subsequent motion?

Index terms: atmosphere motion tumble
tumbling vehicle

Question 167 It is not likely that the airforces on a wing of a general planform oscillating in transonic flow can be determined by purely analytical methods. Is it possible to determine the airforces on a single particular planform, such as the rectuangular one by such methods?

Question 170 Is there any information on how the addition of a "boat-tail" affects the normal force on the body of various angles of incidence?

Index terms: addition angle boattail body
force incidence normal

Question 181 Has any work been done on determining the nature of compressible viscous flow in a straight channel?

Index terms: channel compressible flow nature straight viscous work

Question 182 In what areas, other than low density wind tunnel flows, is viscous compressible flow in slender channels a problem?

Index terms: area channel compressible density flow low problem slender tunnel viscous wind

Question 189 Has anyone programmed a pump design method for a high-speed digital computer?

Index terms: computer design digital high method programmed pump speed

Question 190 Has anyone derived simplified pump design equations from the fundamental three-dimensional equations for incompressible nonviscous flow?

Index terms: design equation flow fundamental incompressible nonviscous pump threedimensional

Question 223 What is the magnitude of second-order wing-body interference at high supersonic Mach number?

Index terms: body high interference Mach magnitude number order second supersonic wing

Question 224 What is the best theoretical method for calculating pressure on the surface of a wing alone?

Index terms: alone calculating method pressure surface theoretical wing

Question 225 How can the effect of the boundary-layer on wing pressure be calculated, and what is its magnitude?

Index terms: boundary calculated effect layer magnitude pressure wing

Question 226 How should the Navier-Stokes difference equations be solved?

Index terms: difference equation navier stokes

Question 227 Which iterative method for solving linear difference equations is most rapidly convergent?

Index terms: convergent difference elliptic equation iterative linear method

Question 230 Technical report on measurement of ablation during flight

Index terms: ablation during flight measurement

Question 250 What determines the onset of shock-induced boundary-layer separation?

Index terms: boundary induced layer onset separation shock

Question 261 Solution of the Blasius problem with threepoint boundary conditions.

Index terms: Blasius boundary condition problem solution threepoint

Question 264 References on Lyapunov/s method on the stability of linear differential equations with periodic coefficients.

Index terms: coefficient differential equation linear Lyapunov method periodic reference stability

Question 266 Work on flow in channels at low Reynolds number.

Index terms: channel flow low number Reynolds work

Question 268 What mode of stalling can be expected for each stage of an axial compressor?

Index terms: axial compressor mode stage stalling

Question 269 Has a criterion been established for determining the axial compressor choking line?

Index terms: axial choking compressor criterion line

Question 272 Has a theory of quasi-conical flows been developed, in supersonic linearized theory, for which the upwash distribution on the lifting surface, apart from being a homogeneous function in the coordinate, is permitted to have a quite general function?

Index terms: coordinate developed distribution flow form function general homogeneous lifting linearized quasiconical supersonic surface theory upwash

Question 273 How does scale height vary with altitude in an atmosphere?

Index terms: altitude atmosphere height scale

Question 274 Jet interference with supersonic flows -- theoretical papers.

Index terms: flow interference jet paper supersonic theoretical

Question 317 Has anyone investigated theoretically whether surface flexibility can stabilize a laminar boundary layer?

Index terms: boundary flexibility laminar layer stabilize surface

Question 323 How do large changes in new mass ratio quantitatively affect wing-flutter?

Index terms: boundary change flutter large mass ratio wing

Question 360 In practice, how close to reality are the assumptions that the flow in a hypersonic shock tube using nitrogen is non-viscous and in thermodynamic equilibrium?

Index terms: assumption close equilibrium flow hypersonic nitrogen non-viscous shock thermodynamic

APPENDIX D

RELEVANCE JUDGEMENTS

Question	Number of Relevant Documents	Relevant Documents
79	3	1302 1436 1437
100	4	1785 1786 1787 1788
116	6	1317 1574 1575 1576 1578 1656
118	5	1324 1378 1666 1667 1670
119	6	1324 1378 1666 1667 1670 2391
121	3	1588 1589 1590
122	5	1597 1598 1688 1708 1713
123	4	1594 1596 1597 1598
126	2	1672 1799
130	4	1680 1681 1682 1683
132	4	1406 1606 1608 1710
136	6	1613 1614 1615 1616 1617 1618
137	6	1420 1793 1794 1795 1796 1797
141	1	1691
145	12	1698 1699 1700 1701 1702 1703 1704 1705 1706 1779 1792 2339
146	9	1681 1698 1699 1700 1701 1702 1703 1779 2339
147	5	1708 1709 1711 1712 1713
148	4	1717 1719 2001 2379
167	4	1916 1919 1920 1921
170	2	1360 1605
181	2	1966 1967

Question	Number of Relevant Documents	Relevant Documents
182	4	1964 1965 1967 1968
189	2	1985 1990
190	7	1984 1985 1986 1987 1988 1989 1990
223	2	2074 2075
224	5	1687 2074 2075 2076 2077
225	5	1569 1572 1655 1687 2077
226	7	2078 2080 2081 2082 2083 2084 2085
227	2	2087 2088
230	6	1983 2099 2100 2101 2103 2104
250	8	1311 1316 1335 1415 1416 1798 2364 2367
261	4	1320 1321 1322 1476
264	2	1367 1451
266	5	1351 1964 1965 1966 1967
268	5	1588 1589 1590 1592 1772
269	4	1588 1589 1590 1591
272	4	1680 1681 1682 1683
273	7	1616 1617 1619 1620 1621 1622 2150
274	5	1409 1973 1974 1997 2061
317	2	2321 2322
323	5	1879 2338 2339 2340 2341
360	8	1656 2157 2274 2313 2316 2317 2318 2319

APPENDIX E

FREQUENCY DISTRIBUTION OF POSTED TERMS

TABLE

FIRST QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1	143	143	FLOW
2	98	241	PRESSURE
3	80	321	DISTRIBUTION
4	73	394	BOUNDARY
5	65	459	MACH
6	62	521	TUNNEL
7	61	582	RATIO
8	61	643	LAYER
9	59	702	WING
10	57	759	SUPERSONIC
11	55	814	WIND
12	55	869	SURFACE
13	53	922	DRAG
14	50	972	COEFFICIENT
15	49	1021	TEST
16	46	1067	ANGLE
17	45	1112	LIFT
18	44	1156	BODY
19	44	1200	SHOCK
20	44	1244	VELOCITY
21	43	1287	SOLUTION
22	42	1329	THEORY
23	40	1369	TEMPERATURE
24	40	1409	WAVE
25	39	1448	CALCULATION
26	37	1485	AERODYNAMIC
27	37	1522	HEAT
28	35	1557	EQUATION
29	35	1592	NUMBER
30	35	1627	TWODIMENSIONAL
31	34	1661	HYPERSONIC
32	33	1694	FLAT
33	32	1726	FORCE

TABLE

SECOND QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
34	32	1758	AIR
35	32	1790	STAGNATION
36	31	1821	SUBSONIC
37	31	1852	EDGE
38	29	1881	ATTACK
39	28	1909	EFFECT
40	28	1937	MODEL
41	28	1965	SPEED
42	27	1992	STREAM
43	27	2019	PLATE
44	27	2046	SEPARATION
45	27	2073	POINT
46	27	2100	REYNOLDS
47	27	2127	MEASUREMENT
48	27	2154	JET
49	27	2181	BLUNT
50	26	2207	HIGH
51	25	2232	SHAPE
52	25	2257	WALL
53	24	2281	DENSITY
54	24	2305	MOMENT
55	23	2328	NOZZLE
56	23	2351	LEADING
57	23	2374	VISCOUS
58	23	2397	THICKNESS
59	23	2420	TRANSFER
60	23	2443	SECTION
61	22	2465	TRANSONIC
62	22	2487	RATE
63	22	2509	LAMINAR
64	22	2531	METHOD
65	22	2553	INTERFERENCE
66	22	2575	GAS
67	21	2596	PITCHING
68	21	2617	ATMOSPHERE
69	21	2638	CONDITION
70	21	2659	STATIC
71	20	2679	CONTROL
72	20	2699	ASPECT
73	20	2719	NORMAL
74	19	2738	MOTION
75	19	2757	LOCATION
76	19	2776	FUNCTION
77	19	2795	FREE
78	19	2814	ANALYSIS
79	19	2833	PROFILE
80	19	2852	VEHICLE
81	18	2870	SKIN

TABLE.--continued

SECOND QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
82	18	2888	TOTAL
83	18	2906	STABILITY
84	18	2924	FLUID
85	18	2942	FINITE
86	18	2960	EXPERIMENTAL
87	18	2978	INTERACTION
88	18	2996	INDUCED
89	18	3014	DEGREE
90	18	3032	CIECULAR
91	17	3049	CYLINDER
92	17	3066	DISTANCE
93	17	3083	VARIATION
94	17	3100	SONIC
95	17	3117	STEADY
96	16	3133	TURBULENT
97	16	3149	INCOMPRESSIBLE
98	16	3165	COMPRESSIBLE
99	16	3181	ALTITUDE
100	16	3197	AEROFOIL
101	15	3212	PREDICTION
102	15	3227	DESIGN
103	15	3242	CHARACTERISTIC
104	15	3257	EXPANSION
105	15	3272	FIELD
106	15	3287	NUMERICAL
107	15	3302	THEORETICAL
108	15	3317	REENTRY
109	14	3331	ROCKET
110	14	3345	SHARP
111	14	3359	VORTEX
112	14	3373	NOSE
113	14	3387	EQUILIBRIUM
114	14	3401	INCIDENCE
115	14	3415	ELLIPTIC
116	14	3429	CENTRE
117	13	3442	DETERMINATION
118	13	3455	DAMPING

TABLE

THIRD QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
119	13	3468	POTENTIAL
120	13	3481	BLADE
121	13	3494	HEATING
122	13	3507	FLIGHT
123	13	3520	FRICTION
124	13	3533	LOW
125	13	3546	SWEPTBACK
126	13	3559	SMALL
127	13	3572	UPPER
128	13	3585	TRANSITION
129	13	3598	REVOLUTION
130	13	3611	SATELLITE
131	12	3623	SPANWISE
132	12	3635	THREEDIMENSIONAL
133	12	3647	THRUST
134	12	3659	TIME
135	12	3671	VORTICITY
136	12	3683	LOADING
137	12	3695	LOAD
138	12	3707	GRADIENT
139	12	3719	AXIAL
140	12	3731	DELTA
141	12	3743	DATA
142	12	3755	CHORDWISE
143	12	3767	CONSTANT
144	11	3778	CONE
145	11	3789	COMPRESSOR
146	11	3800	CURVATURE
147	11	2811	FLUTTER
148	11	3822	DISPLACEMENT
149	11	3833	EXHAUSTING
150	11	3844	LOCAL
151	11	3855	LONGITUDINAL
152	11	3866	APPROXIMATION
153	11	3877	TRAILING
154	11	3888	TUBE
155	10	3898	REDUCTION
156	10	3908	TIP
157	10	3918	WEIGHT
158	10	3928	WEDGE
159	10	3938	SLOPE
160	10	3948	ZERO
161	10	3958	SOLID
162	10	3968	SWEPT
163	10	3978	REACTION
164	10	3988	SPAN
165	10	3998	RECTANGULAR
166	10	4008	PATTERN
167	10	4018	LENGTH

TABLE.--continued

THIRD QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
168	10	4028	MAXIMUM
169	10	4038	MATERIAL
170	10	4048	MASS
171	10	4058	OSCILLATION
172	10	4068	OSCILLATING
173	10	4078	ORBIT
174	10	4088	EXPERIMENT
175	10	4098	PERFORMANCE
176	9	4107	DERIVATIVE
177	9	4116	CONICAL
178	9	4125	POSITION
179	9	4134	ENTHALPY
180	9	4143	DOWNWASH
181	9	4152	FREQUENCY
182	9	4161	RANGE
183	9	4170	OSCILLATORY
184	9	4179	LIFTING
185	9	4188	MODE
186	9	4197	APPROXIMATE
187	9	4206	RELATION
188	9	4215	WAKE
189	9	4224	TRANSIENT
190	9	4233	THIN
191	9	4242	RISE
192	9	4251	UNSTEADY
193	9	4260	REGION
194	9	4269	STREAMLINE
195	8	4277	STIFFNESS
196	8	4285	SPECIFIC
197	8	4293	SYSTEM
198	8	4301	SLENDER
199	8	4309	VERTICAL
200	8	4317	SIZE
201	8	4325	ARBITRARY
202	8	4333	PERIGREE
203	8	4341	MIXING
204	8	4349	MIXED
205	8	4357	LINE
206	8	4365	PLANE
207	8	4373	RADIATION
208	8	4381	PROBLEM
209	8	4389	NOSED
210	8	4397	INDICAL
211	8	4405	INLET
212	8	4413	PLANFORM
213	8	4421	INTEGRAL
214	8	4429	FORWARD
215	8	4437	DOWNSTREAM

TABLE.--continued (3)

THIRD QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
216	8	4445	EDGED
217	8	4453	EXIT
218	8	4461	EXHAUST
219	8	4469	HEIGHT
220	8	4477	CONDUCTION
221	8	4485	DIAMETER
222	8	4493	CURVE
223	8	4501	CHANGE
224	8	4509	BENDING
225	7	4516	PITCH
226	7	4523	CHORD
227	7	4530	DIFFERENTIAL
228	7	4537	CONFIGURATION
229	7	4544	RELAXATION
230	7	4551	DISSOCIATION
231	7	4558	DISTURBANCE
232	7	4565	FORM
233	7	4572	RESULT
234	7	4579	PROPERTY
235	7	4586	PARALLEL
236	7	4593	LINEAR
237	7	4600	SYMMETRICAL
238	7	4607	ROTATING
239	7	4614	SWEEP
240	7	4621	STRESS
241	7	4628	SPHERICAL
242	7	4635	SCALE
243	7	4642	UNIFORM
244	7	4649	SIMULATION
245	7	4656	UPSTREAM
246	7	4663	THERMAL
247	6	4669	THICK
248	6	4675	VARIABLE
249	6	4681	SHEAR
250	6	4687	TYPE
251	6	4693	STALL
252	6	4699	STANDOFF
253	6	4705	VIBRATION
254	6	4711	PERIOD
255	6	4717	LINEARIZED
256	6	4723	PARABOLIC
257	6	4729	PARAMETER
258	6	4735	ONSET
259	6	4741	REFLECTION
260	6	4747	INFINITE
261	6	4753	RIGID
262	6	4759	INVISCID
263	6	4765	MOMENTUM
264	6	4771	PLANETARY

TABLE.--continued (4)

THIRD QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
265	6	4777	GRAVITY
266	6	4783	FLAP
267	6	4789	ECCENTRICITY
268	6	4795	EARTH
269	6	4801	DYNAMIC
270	6	4807	ENERGY
271	6	4813	HALF
272	6	4819	GUST
273	6	4825	IMPELLER
274	6	4831	CONTRACTION
275	6	4837	ROTATIONAL
276	6	4843	BOW
277	6	4849	BLUNTED
278	6	4855	BEHIND
279	6	4861	BASE
280	6	4867	AXISYMMETRIC
281	6	4873	AXIS
282	6	4879	ASYMPTOTIC
283	6	4885	ATMOSPHERIC
284	6	4891	ARC
285	6	4897	AFTERBODY
286	6	4903	ANALYTICAL
287	5	4908	PATH
288	5	4913	ACCELERATION
289	5	4918	BLOWING
290	5	4923	BLOCKAGE
291	5	4928	BUFFETING
292	5	4933	CHOKING
293	5	4938	CHOKED
294	5	4943	CHANNEL
295	5	4948	CENTRIFUGAL
296	5	4953	CONTINUOUS
297	5	4958	PRANDTL
298	5	4963	COMPRESSION
299	5	4968	COMPLETE
300	5	4973	CORRECTION
301	5	4978	DIFFERENCE
302	5	4983	DETACHMENT
303	5	4988	CROSS
304	5	4993	DEPENDENT
305	5	4998	DEFLECTION
306	5	5003	PHOTOGRAPH
307	5	5008	IDEAL
308	5	5013	HOT
309	5	5018	PERTURBATION
310	5	5023	GROWTH
311	5	5028	ENGINE
312	5	5033	RELATIVE

TABLE.--continued (5)

THIRD QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
313	5	5038	ELASTIC
314	5	5043	DIVERGENT
315	5	5048	GLIDER
316	5	5053	GENERALIZED
317	5	5058	REAR
318	5	5063	ENTRY
319	5	5068	EXTERNAL
320	5	5073	MOLECULAR
321	5	5078	MODIFIED
322	5	5083	NEWTONIAN
323	5	5088	ISENTROPIC
324	5	5093	INVESTIGATION
325	5	5098	ONEDIMENSIONAL
326	5	5103	OXYGEN
327	5	5108	NONVISCOUS
328	5	5113	NONLINEAR
329	5	5118	NONEQUILIBRIUM
330	5	5123	LONG
331	5	5128	MAIN
332	5	5133	VISCOSITY
333	5	5138	WORKING
334	5	5143	SURVEY
335	5	5148	STUDY
336	5	5153	SPACE
337	5	5158	SLIP
338	5	5163	STRUCTURE
339	5	5168	STRENGTH
340	5	5173	TESTING
341	5	5178	SINGLE

TABLE

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
342	5	5183	SINKING
343	5	5188	SIMULATED
344	4	5192	TWO
345	4	5196	TRIANGULAR
346	4	5200	TURBOJET
347	4	5204	VANE
348	4	5208	TRANSITIONAL
349	4	5212	TRAJECTORY
350	4	5216	THROAT
351	4	5220	STATE
352	4	5224	WIDTH
353	4	5228	TAIL
354	4	5232	TABLE
355	4	5236	SUCTION
356	4	5240	SURGE
357	4	5244	VECTOR
358	4	5248	STAGE
359	4	5252	SHROUD
360	4	5256	SIDESLIP
361	4	5260	NONLIFTING
362	4	5264	PARTICLE
363	4	5268	PANEL
364	4	5272	PROBE
365	4	5276	OIL
366	4	5280	ORBITAL
367	4	5284	INITIAL
368	4	5288	INTEGRATION
369	4	5292	NITROGEN
370	4	5296	NOISE
371	4	5300	MIXTURE
372	4	5304	NACELLE
373	4	5308	MULTIPLE
374	4	5312	FACTOR
375	4	5316	FACE
376	4	5320	ENTROPY
377	4	5324	PHASE
378	4	5328	ESTIMATION
379	4	5332	RESPONSE
380	4	5336	RADIAL
381	4	5340	FUSELAGE
382	4	5344	FULLY
383	4	5348	FROZEN
384	4	5352	FORMULA
385	4	5356	FOREBODY
386	4	5360	FRACTION
387	4	5364	DIVERGENCE
388	4	5368	PENETRATION
389	4	5372	POWER
390	4	5376	DISSOCIATING

TABLE.--continued (2)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
391	4	5380	SEPARATED
392	4	5384	EFFICIENCY
393	4	5388	EDDY
394	4	5392	SOLAR
395	4	5396	ROLLING
396	4	5400	REAL
397	4	5404	DRIVING
398	4	5408	HEAD
399	4	5412	HUB
400	4	5416	HORSESHOE
401	4	5420	ROTATION
402	4	5424	HELIUM
403	4	5428	SEGMENT
404	4	5432	PROPULSIVE
405	4	5436	DECELERATION
406	4	5440	DETACHED
407	4	5444	CORNER
408	4	5448	COOLING
409	4	5452	COMPRESSIBILITY
410	4	5456	CONVECTION
411	4	5460	CONVERGENT
412	4	5464	CONVECTIVE
413	4	5468	CONDUCTIVITY
414	4	5472	SCHLIEREN
415	4	5476	CHEMICAL
416	4	5480	PERCENT
417	4	5484	CAMBER
418	4	5488	BLASIUS
419	4	5492	ATTACHED
420	4	5496	BEHAVIOR
421	4	5500	ABLATION
422	4	5504	AIRCRAFT
423	3	5507	ANALYTIC
424	3	5510	AMBIENT
425	3	5513	ADIABATIC
426	3	5516	RECOVERY
427	3	5519	SPUTNIK
428	3	5522	AREA
429	3	5525	BLADING
430	3	5528	BLOW
431	3	5531	BLUNTNESS
432	3	5534	STALLING
433	3	5537	BALANCE
434	3	5540	ROUGHNESS
435	3	5543	BOATTAIL
436	3	5546	CHEMICALLY
437	3	5549	REQUIREMENT
438	3	5552	CLOSED

TABLE.--continued (3)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
439	3	5555	STATIONARY
440	3	5558	COMBINED
441	3	5561	CIRCULATION
442	3	5564	PLOTTING
443	3	5567	RAYLEIGH
444	3	5570	CONSTRUCTION
445	3	5573	SPHERE
446	3	5576	CONVERGING
447	3	5579	CONVERGENCE
448	3	5582	ROTOR
449	3	5585	CONTOUR
450	3	5588	STOKES
451	3	5591	CONTINUUM
452	3	5594	COMBUSTION
453	3	5597	STRAIGHT
454	3	5600	COMPUTER
455	3	5603	COORDINATE
456	3	5606	CONVEX
457	3	5609	DEVELOPMENT
458	3	5612	DECAY
459	3	5615	STREAMWISE
460	3	5618	CYLINDRICAL
461	3	5621	DISCONTINUITY
462	3	5624	DISCHARGE
463	3	5627	DIHEDRAL
464	3	5630	STRIP
465	3	5633	STRONG
466	3	5636	STRUCTURAL
467	3	5639	HISTORY
468	3	5642	HEMISPHERICAL
469	3	5645	HEMISPHERE
470	3	5648	SUBLIMATION
471	3	5651	IMPACT
472	3	5654	SOURCE
473	3	5657	SUCCESSIVE
474	3	5660	HYDROGEN
475	3	5663	SEMIINFINITE
476	3	5666	SEMIMAJOR
477	3	5669	INCREMENTAL
478	3	5672	IMPULSE
479	3	5675	SOUND
480	3	5678	DOUBLE
481	3	5681	DURATION
482	3	5684	EFFECTIVE
483	3	5687	ELECTRICAL
484	3	5690	ELASTICITY
485	3	5693	DISSOCIATED
486	3	5696	ROOT
487	3	5699	SWEEPBACK
488	3	5702	SLOTTED

TABLE.--continued (4)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
489	3	5705	SLOT
490	3	5708	FORMATION
491	3	5711	FREEDOM
492	3	5714	FRICTIONAL
493	3	5717	GENERATORS
494	3	5720	SERIES
495	3	5723	GRAPHITE
496	3	5726	GEOMETRY
497	3	5729	FLUX
498	3	5732	FLEXIBILITY
499	3	5735	EXCITATION
500	3	5738	EXPLORER
501	3	5741	SINUSODIAL
502	3	5744	MOVING
503	3	5747	TANGENTIAL
504	3	5750	NACA
505	3	5753	TAPER
506	3	5756	RECOMBINATION
507	3	5759	MISSILE
508	3	5762	NODE
509	3	5765	NEARLY
510	3	5768	NAVIERSTOKES
511	3	5771	INTERMEDIATE
512	3	5774	INFLUENCE
513	3	5777	REGIME
514	3	5780	IONIZED
515	3	5783	IONIZATION
516	3	5786	PISTON
517	3	5789	ITERATIVE
518	3	5792	REATTACHMENT
519	3	5795	OPERATION
520	3	5798	PHENOMENA
521	3	5801	OBLATE
522	3	5804	PARTIAL
523	3	5807	PART
524	3	5810	THERMODYNAMIC
525	3	5813	OUTLET
526	3	5816	OUTBOARD
527	3	5819	REFLECTED
528	3	5822	LOGARITHMIC
529	3	5825	LOSS
530	3	5828	RAE
531	3	5831	REVERSAL
532	3	5834	THREEPOINT
533	3	5837	LIMIT
534	3	5840	LIGHT
535	3	5843	LEEWARD
536	3	5846	RADIUS

TABLE.--continued (5)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
537	3	5849	LARGE
538	3	5852	LATITUDE
539	3	5855	LATERAL
540	3	5858	YAW
541	3	5861	WIRE
542	3	5864	TORSIONAL
543	3	5867	TRANSPORT
544	3	5870	VALUE
545	3	5873	VANISHING
546	3	5876	TWIST
547	2	5878	LIEBMAN
548	2	5880	PERFECT
549	2	5882	THROUGH
550	2	5884	RECIPROCAL
551	2	5886	LIFETIME
552	2	5888	PROPELLER
553	2	5890	LIQUID
554	2	5892	MATCHING
555	2	5894	SIDE
556	2	5896	MANOEUVRE
557	2	5898	RANDOM
558	2	5900	TRANSFORMATION
559	2	5902	MARGIN
560	2	5904	PROPELLANTS
561	2	5906	RADIATIVE
562	2	5908	TRANSLATION
563	2	5910	PERCENTAGE
564	2	5912	LYAPUNOV
565	2	5914	PIVOTAL
566	2	5916	NONSTATIONARY
567	2	5918	NONSTEADY
568	2	5920	THICKENING
569	2	5922	OUTER
570	2	5924	RETROROCKET
571	2	5926	TRIM
572	2	5928	SHIELD
573	2	5930	OBSERVATION
574	2	5932	TUMBLING
575	2	5934	OBLIQUE
576	2	5936	OGIVE
577	2	5938	SHEET
578	2	5940	RICHARDSON
579	2	5942	ONE
580	2	5944	OPEN
581	2	5946	RAREFIED
582	2	5948	ORDER
583	2	5950	TWISTED
584	2	5952	KNEE
585	2	5954	KIRSCHHOFF

TABLE.--continued (6)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
586	2	5956	KINETIC
587	2	5958	KILOMETRE
588	2	5960	KERNEL
589	2	5962	KELVIN
590	2	5964	TERMINAL
591	2	5966	INVERSION
592	2	5968	INTERSECTING
593	2	5970	TENSION
594	2	5972	INTERNAL
595	2	5974	INTERFACE
596	2	5976	INNER
597	2	5978	TEFLON
598	2	5980	NEAR
599	2	5982	NAVIER
600	2	5984	TECHNIQUE
601	2	5986	NET
602	2	5988	SINK
603	2	5990	UNSWEPT
604	2	5992	MODAL
605	2	5994	TAPERED
606	2	5996	NATURAL
607	2	5998	NARROW
608	2	6000	MULTISTAGE
609	2	6002	UPWASH
610	2	6004	MOVEMENT
611	2	6006	SHADOWGRAPH
612	2	6008	MOLECULE
613	2	6010	PIVOT
614	2	6012	MECHANICS
615	2	6014	MEAN
616	2	6016	MEYER
617	2	6018	MERIDIONAL
618	2	6020	MERGED
619	2	6022	PRIMARY
620	2	6024	EXCESS
621	2	6026	SLAB
622	2	6028	ETHYLENE
623	2	6030	ESCAPE
624	2	6032	EQUIVALENT
625	2	6034	FACED
626	2	6036	EXTENSION
627	2	6038	EXPOSED
628	2	6040	REACTING
629	2	6042	FIRST
630	2	6044	FILAMENT
631	2	6046	VISCID
632	2	6048	FLAME
633	2	6050	FIXED

TABLE.--continued (7)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
634	2	6052	FLEXIBLE
635	2	6054	QUASI
636	2	6056	ROLL
637	2	6058	VORTICES
638	2	6060	PHOTOGRAPHIC
639	2	6062	PENETRATING
640	2	6064	FLUCTUATION
641	2	6066	GLIDE
642	2	6068	TAB
643	2	6070	GENERATED
644	2	6072	FUEL
645	2	6074	FRONT
646	2	6076	FREEZING
647	2	6078	SYMMETRIC
648	2	6080	SWEPTFORWARD
649	2	6082	FOURIER
650	2	6084	FORCED
651	2	6086	FOLDING
652	2	6088	WIDE
653	2	6090	ENTERING
654	2	6092	EMISSIVITY
655	2	6094	WINDWARD
656	2	6096	ELLIPTICAL
657	2	6098	WINGED
658	2	6100	ELEMENT
659	2	6102	DISTRIBUTED
660	2	6104	SLOWLY
661	2	6106	DIVERGING
662	2	6108	DIURNAL
663	2	6110	YAWED
664	2	6112	QUASICONICAL
665	2	6114	DISK
666	2	6116	ZONE
667	2	6118	ELECTRICALLY
668	2	6120	SODIUM
669	2	6122	DOUBLET
670	2	6124	SUPPORT
671	2	6126	PROCESS
672	2	6128	INCLINATION
673	2	6130	INCIPIENT
674	2	6132	INCONEL
675	2	6134	SUPERPOSITION
676	2	6136	GROUND
677	2	6138	GROSS
678	2	6140	HEATED
679	2	6142	GUIDE
680	2	6144	ROTARY
681	2	6146	HARMONICALLY
682	2	6148	HYDRODYNAMIC

TABLE.--continued (8)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
683	2	6150	SPACING
684	2	6152	HYSTERESIS
685	2	6154	HYPERVELOCITY
686	2	6156	HIGHLY
687	2	6158	HOMOGENEOUS
688	2	6160	DIFFERENTIALLY
689	2	6162	DIRECTIONAL
690	2	6164	PROGRESSIVE
691	2	6166	CURVED
692	2	6168	DEFLECTED
693	2	6170	REMOVAL
694	2	6172	DEVIATION
695	2	6174	SECTIONAL
696	2	6176	DEVELOPED
697	2	6178	RESONANCE
698	2	6180	SPECTRA
699	2	6182	SECONDORDER
700	2	6184	COPPER
701	2	6186	CRITICAL
702	2	6188	COUETTE
703	2	6190	CONCAVE
704	2	6192	COMPONENT
705	2	6194	SECOND
706	2	6196	SEASON
707	2	6198	PUMP
708	2	6200	SPHERICALLY
709	2	6202	COMBINATION
710	2	6204	COLLISION
711	2	6206	COLD
712	2	6208	PREWHIRL
713	2	6210	CHAMBER
714	2	6212	PERIODIC
715	2	6214	STARTING
716	2	6216	BUMP
717	2	6218	BUZZ
718	2	6220	BURNED
719	2	6222	CASCADE
720	2	6224	CARBON
721	2	6226	BALLISTIC
722	2	6228	ROW
723	2	6230	PROPULSION
724	2	6232	AUGMENTATION
725	2	6234	ATTENUATION
726	2	6236	ATTACHMENT
727	2	6238	AVERAGE
728	2	6240	STALLED
729	2	6242	BLOWDOWN
730	2	6244	BLEED

TABLE.--continued (9)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
731	2	6246	ATOMIC
732	2	6248	PLATES
733	2	6250	POHLHAUSEN
734	2	6252	ARTIFICIAL
735	2	6254	BEAM
736	2	6256	BETWEEN
737	2	6258	APPLIED
738	2	6260	APOGEE
739	2	6262	ADJACENT
740	2	6264	AHEAD
741	2	6266	PRESCRIBED
742	2	6268	PERPENDICULARLY
743	2	6270	STACKING
744	2	6272	AMOUNT
745	2	6274	STABLE
746	1	6275	SAIL
747	1	6276	POLYMER
748	1	6277	ANALOGY
749	1	6278	AMPLITUDE
750	1	6279	ALUMINUM
751	1	6280	PHOTORECORDING
752	1	6281	AIRSPEED
753	1	6282	AILERON
754	1	6283	PRECIPITATION
755	1	6284	ALTERNATING
756	1	6285	ALLOY
757	1	6286	ALLMOVABLE
758	1	6287	AEROELASTICITY
759	1	6288	ADVERSE
760	1	6289	SAFETY
761	1	6290	AEROTHERMODYNAMIC
762	1	6291	AEROPLANE
763	1	6292	ADJUSTABLE
764	1	6293	ADDITION
765	1	6294	ACTUAL
766	1	6295	ACTIVITY
767	1	6296	ACTIVE
768	1	6297	ACOUSTIC
769	1	6298	APPARENT
770	1	6299	APPARATUS
771	1	6300	APEX
772	1	6301	APPROACHING
773	1	6302	APPROACH
774	1	6303	APPEARANCE
775	1	6304	STAGGER
776	1	6305	RUNNING
777	1	6306	RECORD
778	1	6307	RADIATOR
779	1	6308	ANTISYMMETRIC
780	1	6309	ANNULUS

TABLE.--continued (10)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
781	1	6310	ANEMOMETER
782	1	6311	SQUARE
783	1	6312	ABOVE
784	1	6313	ABOUT
785	1	6314	ABLATING
786	1	6315	SANDPAPER
787	1	6316	ACCURATE
788	1	6317	ACCOMMODATION
789	1	6318	ACCELERATING
790	1	6319	SALT
791	1	6320	PAST
792	1	6321	PASSING
793	1	6322	PARTITION
794	1	6323	RADIOACTIVE
795	1	6324	PEAKY
796	1	6325	PEAK
797	1	6326	PAY
798	1	6327	PENDULUM
799	1	6328	PENALTY
800	1	6329	PECLET
801	1	6330	ABEL
802	1	6331	ACCELERATED
803	1	6332	ABSORPTION
804	1	6333	ABSOLUTE
805	1	6334	ABRUPT
806	1	6335	BIPLANE
807	1	6336	BIOT
808	1	6337	BENEATH
809	1	6338	ROUTINE
810	1	6339	BEAD
811	1	6340	BASIC
812	1	6341	STAGGERED
813	1	6342	ROUNDINGOFF
814	1	6343	RESEARCH
815	1	6344	BELT
816	1	6345	BANGBANG
817	1	6346	BAND
818	1	6347	BALSA
819	1	6348	BALLOTINI
820	1	6349	ASSOCIATED
821	1	6350	ARROW
822	1	6351	RUDDER
823	1	6352	ATLAS
824	1	6353	ASYMMETRIC
825	1	6354	SPOILER
826	1	6355	RULE
827	1	6356	ATOM
828	1	6357	ARRANGEMENTS
829	1	6358	ARGON

TABLE.--continued (11)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
830	1	6359	ARDC
831	1	6360	SATURATION
832	1	6361	STANDARD
833	1	6362	ROUNDED
834	1	6363	RESERVOIR
835	1	6364	BLUNTING
836	1	6365	SPLITTER
837	1	6366	PROLATE
838	1	6367	BIRNBAUM
839	1	6368	BLUFF
840	1	6369	BLOWN
841	1	6370	BLOWER
842	1	6371	AVRO
843	1	6372	AUTOPILOT
844	1	6373	AUTOMATIC
845	1	6374	PICKUP
846	1	6375	ROUTTHURWITZ
847	1	6376	AXIALLY
848	1	6377	BAFFLES
849	1	6378	BACK
850	1	6379	CARBORUNDUM
851	1	6380	CAPTURE
852	1	6381	CAPACITY
853	1	6382	CENTIMETRE
854	1	6383	CENTERING
855	1	6384	CARRYING
856	1	6385	SPIN
857	1	6386	PERPENDICULAR
858	1	6387	CAMBERED
859	1	6388	CALCULATING
860	1	6389	CAPACITANCE
861	1	6390	CAPABILITY
862	1	6391	CANTELEVERED
863	1	6392	CANTELEVER
864	1	6393	BURSTING
865	1	6394	BUOYANCY
866	1	6395	BUFFET
867	1	6396	BUCKLING
868	1	6397	SPIKED
869	1	6398	BREATHING
870	1	6399	BRADING
871	1	6400	BOUND
872	1	6401	BOOST
873	1	6402	STATICALLY
874	1	6403	SCHLICHTING
875	1	6404	SPIKE
876	1	6405	CHLORIDE
877	1	6406	CHARGED

TABLE.--continued (12)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
878	1	6407	SPHEROID
879	1	6408	PRODUCTION
880	1	6409	CESSATION
881	1	6410	CENTRAL
882	1	6411	SCAVENGING
883	1	6412	SCALING
884	1	6413	RESISTANCE
885	1	6414	CHOKE
886	1	6415	STATOR
887	1	6416	CLASSICAL
888	1	6417	CIRCUMFERENTIAL
889	1	6418	CIRCULATORY
890	1	6419	STATISTICAL
891	1	6420	COCURRENT
892	1	6421	CLIPPED
893	1	6422	PROXIMITY
894	1	6423	POUND
895	1	6424	CIRCULATING
896	1	6425	CIRCUIT
897	1	6426	STEEL
898	1	6427	RELIABILITY
899	1	6428	CONDUCTING
900	1	6429	STIFFENER
901	1	6430	CONSTRAINT
902	1	6431	CONSERVATION
903	1	6432	STEP
904	1	6433	RESONANT
905	1	6434	PURE
906	1	6435	CONICALLY
907	1	6436	CONDENSATION
908	1	6437	CONCENTRIC
909	1	6438	CONCENTRATION
910	1	6439	CONCENTRATED
911	1	6440	CONTINUITY
912	1	6441	CONTINUATION
913	1	6442	CONTACT
914	1	6443	STORES
915	1	6444	STORE
916	1	6445	STOICHIOMETRIC
917	1	6446	CONTRACTING
918	1	6447	STING
919	1	6448	STILL
920	1	6449	PLUNGING
921	1	6450	CONTROLLING
922	1	6451	CONTRIBUTION
923	1	6452	SPECTRUM
924	1	6453	SEASONAL
925	1	6454	COMPRESSED

TABLE.--continued (13)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
926	1	6455	STRATFORD
927	1	6456	SECONDARY
928	1	6457	COMPOSED
929	1	6458	QUALITY
930	1	6459	COMPUTATION
931	1	6460	COMPREG
932	1	6461	COMPOUND
933	1	6462	COMPOSITION
934	1	6463	COMPOSITE
935	1	6464	COUNTERROTATING
936	1	6465	COUNTERCURRENT
937	1	6466	CORRELATED
938	1	6467	CRITERION
939	1	6468	COUPON
940	1	6469	COUPLED
941	1	6470	SPECIMEN
942	1	6471	COROTATING
943	1	6472	STREAMS
944	1	6473	COOLED
945	1	6474	DIETZE
946	1	6475	DIATOMIC
947	1	6476	STREAMTUBE
948	1	6477	DIAPHRAGM
949	1	6478	RAW
950	1	6479	DESTABILIZING
951	1	6480	DERIVATION
952	1	6481	SELECTED
953	1	6482	PROJECTION
954	1	6483	DEFICIENCY
955	1	6484	STREET
956	1	6485	PROTECTION
957	1	6486	DAYTIME
958	1	6487	DAYTONIGHT
959	1	6488	SPECIES
960	1	6489	DECREASE
961	1	6490	DECELERATING
962	1	6491	DECAYING
963	1	6492	SPANNING
964	1	6493	PITCHUP
965	1	6494	DELAY
966	1	6495	REMOVED
967	1	6496	QUARTZ
968	1	6497	CYCLES
969	1	6498	POWELL
970	1	6499	DAMPOMETER
971	1	6500	SEEDED
972	1	6501	CROSSED
973	1	6502	CROSSECTION
974	1	6503	CROPPED

TABLE.--continued (14)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
975	1	6504	CURRENT
976	1	6505	CRUISING
977	1	6506	CROSSING
978	1	6507	CROSSFLOW
979	1	6508	STRINGER
980	1	6509	DIRECTION
981	1	6510	DIFFUSION
982	1	6511	DIFFUSER
983	1	6512	DISEQUILIBRIUM
984	1	6513	DISCRETE
985	1	6514	DISCOVER
986	1	6515	DISCONTINUOUS
987	1	6516	DIRECT
988	1	6517	DIOXIDE
989	1	6518	DIMENSIONLESS
990	1	6519	DIMENSION
991	1	6520	HORIZONTAL
992	1	6521	HOLE
993	1	6522	HOLDING
994	1	6523	HINGED
995	1	6524	SUBJECTED
996	1	6525	HEXACHLORETHANE
997	1	6526	HEMISPHERICALLY
998	1	6527	RELEASE
999	1	6528	HELMHOLZ
1000	1	6529	HEAVY
1001	1	6530	SELFINDUCED
1002	1	6531	SELF
1003	1	6532	SUBSTANTIAL
1004	1	6533	IGNITED
1005	1	6534	IDEALIZED
1006	1	6535	SUDDEN
1007	1	6536	HYDROCARBON
1008	1	6537	HUMIDITY
1009	1	6538	SEMIELLIPSOID
1010	1	6539	HUGONOIT
1011	1	6540	HARTMANN
1012	1	6541	HANDLING
1013	1	6542	GYROSCOPIC
1014	1	6543	GUN
1015	1	6544	SUN
1016	1	6545	SOUNDING
1017	1	6546	PROMOTION
1018	1	6547	GREEN
1019	1	6548	PRACTICAL
1020	1	6549	INCREASED
1021	1	6550	INCLINED
1022	1	6551	INCIDENT

TABLE.--continued (15)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1023	1	6552	INBOARD
1024	1	6553	IN
1025	1	6554	IMPROVED
1026	1	6555	SUPERSATELLITE
1027	1	6556	INDICATOR
1028	1	6557	INCREMENT
1029	1	6558	INCREASING
1030	1	6559	DUE
1031	1	6560	DRY
1032	1	6561	DROOP
1033	1	6562	SUPPORTED
1034	1	6563	DOMAIN
1035	1	6564	DIVISION
1036	1	6565	RELATIONSHIP
1037	1	6566	PERFORATED
1038	1	6567	DRIERS
1039	1	6568	DRIVEN
1040	1	6569	DRIVE
1041	1	6570	DRILLING
1042	1	6571	DRILLED
1043	1	6572	SOFT
1044	1	6573	EIGENVALVE
1045	1	6574	ELECTRIC
1046	1	6575	SUPPORTING
1047	1	6576	ROOM
1048	1	6577	ROOFTOP
1049	1	6578	SENSOR
1050	1	6579	PILOTING
1051	1	6580	PHUGOID
1052	1	6581	DISSIPATIVE
1053	1	6582	DISPLACED
1054	1	6583	YAWING
1055	1	6584	WOOD
1056	1	6585	SLUG
1057	1	6586	RESTART
1058	1	6587	DISTORTION
1059	1	6588	SMOOTH
1060	1	6589	REST
1061	1	6590	WITHIN
1062	1	6591	ELEMENTARY
1063	1	6592	ELECTROMAGNETICAL
1064	1	6593	ELECTROMAGNETIC
1065	1	6594	END
1066	1	6595	EMITTED
1067	1	6596	SEMIVERTEX
1068	1	6597	PRODUCT
1069	1	6598	ELIMINATION
1070	1	6599	ELEVON
1071	1	6600	ELEVATED

TABLE.--continued (16)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1072	1	6601	WHIRL
1073	1	6602	PHOTOMULTIPLIER
1074	1	6603	FORCING
1075	1	6604	WEISSINGER
1076	1	6605	POLYGON
1077	1	6606	RESULTANT
1078	1	6607	WEAKENING
1079	1	6608	FREESTREAM
1080	1	6609	FREEENTERING
1081	1	6610	WAVELENGTH
1082	1	6611	SLIPSTREAM
1083	1	6612	FRICTIONLESS
1084	1	6613	SETTING
1085	1	6614	PROPAGATION
1086	1	6615	FREON
1087	1	6616	SLIGHTLY
1088	1	6617	POLAR
1089	1	6618	FUSED
1090	1	6619	PLASTIC
1091	1	6620	GEAR
1092	1	6621	GAUGE
1093	1	6622	FUSION
1094	1	6623	WATER
1095	1	6624	SYSTEMATIC
1096	1	6625	SERVO
1097	1	6626	GENERAL
1098	1	6627	WARREN12
1099	1	6628	RETARDING
1100	1	6629	GRAPHICAL
1101	1	6630	GRAIN
1102	1	6631	WARD
1103	1	6632	TABULATION
1104	1	6633	GLASS
1105	1	6634	GIVEN
1106	1	6635	ROD
1107	1	6636	GRAVITATIONAL
1108	1	6637	GRATE
1109	1	6638	PROPAGATING
1110	1	6639	FLOWMETER
1111	1	6640	WAGNER
1112	1	6641	FLARE
1113	1	6642	FLAPPING
1114	1	6643	PORTION
1115	1	6644	FLUTTERING
1116	1	6645	VONKARMAN
1117	1	6646	TAILBOOM
1118	1	6647	FLEXURE
1119	1	6648	FLEXURAL

TABLE.--continued (17)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1120	1	6649	VOLUME
1121	1	6650	FIVESTAGE
1122	1	6651	FISSION
1123	1	6652	PRINCIPLE
1124	1	6653	FILTER
1125	1	6654	FILLING
1126	1	6655	VIBRATIONALLY
1127	1	6656	VIBRATIONAL
1128	1	6657	FIRING
1129	1	6658	FINAL
1130	1	6659	FEEDBACK
1131	1	6660	FAST
1132	1	6661	FAR
1133	1	6662	FALL
1134	1	6663	EXPRESSION
1135	1	6664	EXPONENTIAL
1136	1	6665	EXPONENT
1137	1	6666	VERY
1138	1	6667	SEVERELY
1139	1	6668	EXTERNALLY
1140	1	6669	EXTENT
1141	1	6670	EXTREME
1142	1	6671	EXTRAPOLATED
1143	1	6672	SIX
1144	1	6673	FAIR
1145	1	6674	FAILURE
1146	1	6675	FAHRENHEIT
1147	1	6676	VENTURIS
1148	1	6677	ERROR
1149	1	6678	EROSION
1150	1	6679	EQUIVALENCE
1151	1	6680	SKIP
1152	1	6681	ESTIMATE
1153	1	6682	PROCEDURE
1154	1	6683	EQUIPMENT
1155	1	6684	EQUATORIAL
1156	1	6685	SKEWED
1157	1	6686	SEVERE
1158	1	6687	ENVIRONMENTAL
1159	1	6688	ENTRANCE
1160	1	6689	EXOTHERMIC
1161	1	6690	EXITING
1162	1	6691	VARIATIONAL
1163	1	6692	TAILLESS
1164	1	6693	RELAY
1165	1	6694	EXCITED
1166	1	6695	TAILPLANE
1167	1	6696	POSITIVE

TABLE.--continued (18)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1168	1	6697	EXACT
1169	1	6698	EVAPORATION
1170	1	6699	EVAPORATING
1171	1	6700	EVALUATION
1172	1	6701	VAPOURIZATION
1173	1	6702	MESH
1174	1	6703	MEDIUM
1175	1	6704	VAPOUR
1176	1	6705	MIDDLE
1177	1	6706	MIDCOURSE
1178	1	6707	MIDAS
1179	1	6708	VANGUARD
1180	1	6709	PIPE
1181	1	6710	MECHANISM
1182	1	6711	METHANE
1183	1	6712	METEROID
1184	1	6713	METEORITE
1185	1	6714	VANELESS
1186	1	6715	POINTED
1187	1	6716	MOUNTED
1188	1	6717	VALUED
1189	1	6718	MOLYBDENUM
1190	1	6719	MOL
1191	1	6720	VACUUM
1192	1	6721	TAP
1193	1	6722	TANGENT
1194	1	6723	UPRATING
1195	1	6724	UNWIND
1196	1	6725	UNTAPERED
1197	1	6726	TAPPING
1198	1	6727	PINE
1199	1	6728	TARGET
1200	1	6729	REDUCTED
1201	1	6730	REDUCED
1202	1	6731	MISSION
1203	1	6732	MOISTURE
1204	1	6733	MODULUS
1205	1	6734	MODERATE
1206	1	6735	MINOR
1207	1	6736	MINIMUM
1208	1	6737	MILES
1209	1	6738	MILD
1210	1	6739	UNSTALLING
1211	1	6740	NEUTRAL
1212	1	6741	NEARTRIANGULAR
1213	1	6742	UNSTALLED
1214	1	6743	UNITY
1215	1	6744	UNIT
1216	1	6745	NAUTICAL

TABLE.--continued (19)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1217	1	6746	TAYLOR
1218	1	6747	SINGLY
1219	1	6748	SHAPED
1220	1	6749	NIGHTTIME
1221	1	6750	SINGULAR
1222	1	6751	NONCATALYTIC
1223	1	6752	NONABLATING
1224	1	6753	NOLIFT
1225	1	6754	INSULATED
1226	1	6755	INSTRUMENTATION
1227	1	6756	INSTABILITY
1228	1	6757	UNIDIRECTIONAL
1229	1	6758	POSSION
1230	1	6759	INTERIOR
1231	1	6760	UNHEATED
1232	1	6761	TELEMETERING
1233	1	6762	INTERNALLY
1234	1	6763	INTERJECTORY
1235	1	6764	REGRESSION
1236	1	6765	INTEGRATING
1237	1	6766	INTAKE
1238	1	6767	UNFOLDING
1239	1	6768	INJECTION
1240	1	6769	INJECTED
1241	1	6770	INITIATED
1242	1	6771	INITIALLY
1243	1	6772	INFINITESIMALLY
1244	1	6773	RIGIDITY
1245	1	6774	INFINITELY
1246	1	6775	INEXORABLE
1247	1	6776	INERTIA
1248	1	6777	RIEMANN
1249	1	6778	POSTBUCKLING
1250	1	6779	INDIVIDUAL
1251	1	6780	INDIRECT
1252	1	6781	UNDISSOCIATED
1253	1	6782	UNDERWATER
1254	1	6783	INTERPLANETARY
1255	1	6784	UNCOUPLED
1256	1	6785	ISOBAR
1257	1	6786	IRROTATIONAL
1258	1	6787	RIGIDLY
1259	1	6788	ION
1260	1	6789	IODIDE
1261	1	6790	ISOTROPIC
1262	1	6791	ISOTOPE
1263	1	6792	ISOENERGETIC
1264	1	6793	ISOBARIC
1265	1	6794	UNCAMBERED

TABLE.--continued (20)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1266	1	6795	UNBOUNDED
1267	1	6796	ULTRAVIOLET
1268	1	6797	TWODIMENSIONS
1269	1	6798	KUSSNER
1270	1	6799	KINK
1271	1	6800	THEODORSEN
1272	1	6801	JEFFERYHAMEL
1273	1	6802	ISSUING
1274	1	6803	KARMAN
1275	1	6804	JUMO
1276	1	6805	JOUKOWSKI
1277	1	6806	JOHANNESEN
1278	1	6807	ORDINATE
1279	1	6808	TURNING
1280	1	6809	OPTIMUM
1281	1	6810	OPTIMIZATION
1282	1	6811	THEOREM
1283	1	6812	REARWARD
1284	1	6813	RANKLINE
1285	1	6814	OSCILLOGRAPH
1286	1	6815	ORTHOGONAL
1287	1	6816	ORIGINATING
1288	1	6817	ORIFICE
1289	1	6818	ORIENTATION
1290	1	6819	TURBULENCE
1291	1	6820	TURBOMACHINE
1292	1	6821	ONEDIMENSION
1293	1	6822	SIMPLY
1294	1	6823	OILFLOW
1295	1	6824	OCTAGONAL
1296	1	6825	TUNGSTEN
1297	1	6826	OBLATENESS
1298	1	6827	SIMPLE
1299	1	6828	NUCLEAR
1300	1	6829	NPL
1301	1	6830	OVERRELAXATION
1302	1	6831	OVEREXPANDED
1303	1	6832	OVERALL
1304	1	6833	TRUNCATED
1305	1	6834	SIMILITUDE
1306	1	6835	PAIR
1307	1	6836	TRIANGLE
1308	1	6837	THICKENED
1309	1	6838	OUTFLOW
1310	1	6839	THERMALLY
1311	1	6840	SIMILARITY
1312	1	6841	TRAVERSE
1313	1	6842	SHIELDING
1314	1	6843	REFERENCE

TABLE.--continued (21)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1315	1	6844	TRAVELLING
1316	1	6845	NONPERFECT
1317	1	6846	NONPARALLEL
1318	1	6847	TRANSVERSE
1319	1	6848	NOTSOSLENDER
1320	1	6849	NOSEPIECE
1321	1	6850	SILICA
1322	1	6851	SHORT
1323	1	6852	NONDISSIPATIVE
1324	1	6853	NONDISSIPATING
1325	1	6854	TRANSPIRATION
1326	1	6855	MAGNESIUM
1327	1	6856	LUNISOLAR
1328	1	6857	SIDEWASH
1329	1	6858	LORENZ
1330	1	6859	THREE
1331	1	6860	LUMINOUS
1332	1	6861	LUMINOSITY
1333	1	6862	POISEUILLE
1334	1	6863	LOCKHEED
1335	1	6864	LOCALLY
1336	1	6865	MARTIAN
1337	1	6866	MANOMETER
1338	1	6867	TRANSFORMATION
1339	1	6868	MAJOR
1340	1	6869	MAGNITUDE
1341	1	6870	RAMP
1342	1	6871	MATRIX
1343	1	6872	MAGNIFICATION
1344	1	6873	MAGNETOPLASMA
1345	1	6874	MAGNETOFLUIDMECH
1346	1	6875	MAGNETIC
1347	1	6876	TRAJECTORIES
1348	1	6877	PROPELLED
1349	1	6878	LOADED
1350	1	6879	TORSO
1351	1	6880	REVERSED
1352	1	6881	LIFE
1353	1	6882	REVERSIBILITY
1354	1	6883	LIQUIFACTION
1355	1	6884	LINERS
1356	1	6885	LINEARIZATION
1357	1	6886	TORQUE
1358	1	6887	THWAITES
1359	1	6888	REENTRANT
1360	1	6889	LEAD
1361	1	6890	TOLLMENSCHLICHT
1362	1	6891	LIBRATION

TABLE.--continued (22)

FOURTH QUARTER DELETIONS

Class	Freq.	Cum. Freq.	Term
1363	1	6892	LESS
1364	1	6893	TOLLMIEN
1365	1	6894	LAW
1366	1	6895	LATERALLY
1367	1	6896	TIMEOPTIMUM
1368	1	6897	PLANET
1369	1	6898	LAMINARIZATION
1370	1	6899	L-METHOD

APPENDIX F

SMALL DOCUMENT FILE

ablation	1978 2099 2100 2101
about	1792
action	
accuracy	
addition	1974
aerodynamic	1360 1406 1415 1594 1597 1598 1606 1608 1613 1615 1671 1675 1677 1687 1688 1698 1704 1707 1708 1709 1711 1712 1717 1748 1783 1792 1798 1919 1972 1981 1982 1995 2104 2339 2342 2379 2391
aerofoil	1316 1409 1416 1467 1597 1672 1681 1687 1701 1702 1703 1706 1797 1798 1799 2153
aeroplane	1783
air	1302 1416 1437 1576 1578 1588 1592 1613 1614 1615 1616 1617 1619 1620 1621 1622 1672 1691 1695 1772 1874 1970 1991 1992 1995 1997 2083 2101 2157 2274 2313 2379
alone	
altitude	1302 1574 1578 1606 1620 1621 1717 1719 1971 1983 2102 2103 2150 2274 2379 2391
analysis	1360 1437 1576 1588 1589 1590 1596 1666 1680 1836 1974 1984 1988 1989 2099 2100 2317 2339 2391
analytical	1606 1613 1670 1719 2187

angle 1360 1420 1443 1572 1575 1590 1592 1619 1655 1672 1681 1688 1693 1694 1695 1698 1704 1707 1708 1709 1711 1712 1713 1717 1719 1772 1782 1786 1788 1792 1973 1985 1988 1989 1993 1997 2001 2074 2075 2077 2154 2274 2339 2341 2364 2379

apex 1694

area 1590 1788 1799

assumed

assumption

atmosphere 1302 1436 1509 1613 1614 1615 1616 1617 1619 1620 1621 1622 1717 1719 1982 1983 2001 2077 2102 2103 2391

axial 1588 1589 1590 1592 1709 1772 1836 1967 1987 1988 1995 2001

blast

Blasius 1320 1321 1322 1476

boattail 1360 1713 1997

body 1317 1360 1572 1574 1575 1576 1578 1606 1655 1666 1670 1672 1681 1688 1710 1717 1719 1792 1921 1966 1967 1973 1978 1981 1983 1991 1992 1993 1994 1995 2002 2074 2075 2099 2104 2111 2153 2155 2157 2274 2318 2319 2321 2391 boundary 1302 1311 1316 1320 1321 1322 1324 1335 1378 1383 1406 1415 1416 1436 1437 1476 1569 1572 1576 1606 1608 1655 1666 1667 1671 1672 1675 1696 1710 1728 1785 1787 1788 1792 1793 1794 1796 1797 1798 1799 1879 1964 1965 1966 1972 1973 1974 1978 1981 1982 1992 1997 2076 2080 2081 2082 2083 2087 2088 2099 2100 2154 2155 2157 2187 2274 2313 2317 2319 2321 2322 2364 2367

calculated

calculating 1677

channel 1351 1963 1966 2083 2084

Chapman

change 1590 1616 1617 1622 1699 1968 2101 2154

choking 1590 1672 1799 2154 2155

close

closely

coefficient 1302 1311 1316 1360 1383 1415 1443 1451 1569 1588 1590 1592 1655 1671 1672 1687 1688 1693 1694 1696 1699 1700 1701 1702 1704 1707 1709 1711 1713 1719 1772 1779 1794 1797 1798 1836 1919 1964 1965 1980 1992 1995 2078 2080 2081 2082 2084 2321 2342 2391 combustion 1691 1978 2100

comparison

compressible 1383 1406 1409 1676 1680 1701 1703 1705 1748 1779 1967 1984 1985 1990 2076 2100

compressor 1588 1589 1590 1591 1592 1772 1984 1985 1986 1987 1990

computer 1321 1677 1836

condition 1320 1321 1322 1406 1476 1574 1575 1656 1672 1704 1728 1978 1981 1988 2081 2082 2083 2099 2154 2274 2319

control 1367 1415 1416 1451 1598 1672 1704 1708 1711 1748 1792 1798 1836 1968 1970 1971 1972 1973 1974 2077

conventional

convergent 1575 1692 1693 1694

coordinate 1696 2080 2082

correction 1672 1783 1799 1968 2154

criterion 1451

current 2083

cylinder 1360 1605 1785 1786 1787 1788 1800 1973 1978 2074 2078 2081 2083 2084 2100 2104 2153

delta 1420 1677 1682 1683 1699 1709 1711 1779 1796 1916 1921 2111 density 1317 1443 1574 1576 1614 1615 1616 1617 1619 1620 1621 1622 1670 1691 1695 1879 2103 2150 2154 2274 2319 2322 2391

derivative 1594 1597 1598 1688 1748 1782 1792 1916 2342

design 1367 1415 1416 1590 1592 1596 1797 1880 1921 1964 1968 1985 1986 2001 2157

developed 1966 1967

difference 1967 2080 2081 2082 2088

different

differential 1451 1666 1708 1916 2087 2088 2111

digital

dissociated 1437 1576 1691

distribution 1316 1321 1335 1351 1383 1415 1420 1443 1467 1509 1572 1574 1578 1588 1590 1655 1671 1675 1677 1680 1681 1682 1683 1687 1692 1693 1694 1695 1696 1699 1703 1704 1705 1707 1710 1729 1783 1787 1788 1794 1798 1800 1836 1919 1920 1921 1963 1971 1972 1981 1982 1984 1985 1988 1989 1990 1991 1992 1993 1994 1995 2002 2074 2075 2076 2078 2080 2083 2084 2153 2155 2157 2274 2319 2321 2339 2364 2367 2391 drag 1383 1406 1415 1416 1420 1467 1569 1575 1613 1614 1615 1616 1617 1618 1619 1622 1671 1672 1676 1677 1681 1683 1688 1708 1709 1711 1712 1713 1719 1785 1786 1787 1794 1796 1797 1800 1921 1973 1991 1992 1994 1995 2002 2076 2078 2080 2081 2083 2084 2155 2321 2379 2391

during

dynamic 1367 1598 1717 1783 1916 2001

edge 1311 1409 1415 1416 1420 1659 1572 1655 1675 1688 1707 1712 1772 1788 1792 1793 1794 1796 1797 1798 1971 1988 1989 2074 2077 2104 2157

effect 1302 1311 1572 1588 1606 1655 1656 1667 1671 1672 1675 1701 1783 1792 1798 1799 1916 1965 1971 1972 1973 1997 2001 2100 2102 2153 2274 2319

effective 2077 2099 2100

elliptic 1613 1614 1615 1616 1618 1684 1688 1699 1712 1785 1787 1788 2088 2342

Enskog

enthalpy 1302 1378 1406 1436 1606 1667 1691 1983 2099

equation 1451 1467 1476 1575 1591 1656 1666 1677 1680 1681 1682 1700 1703 1704 1705 1717 1719 1785 1916 1963 1965 equation cont. 1978 1981 1987 2061 2078 2081 2082 2085 2087 2088 2111 2317 2322 2391

equilibrium 1302 1406 1574 1575 1576 1606 1656 1691 1968 2077 2100 2157 2274 2319

experimental 1360 1437 1666 1670 1688 1836 1964 1965 1974 2081 2083 2100 2101 2104 2187 2313 2317 2340

facility

far

finite 1415 1575 1656 1672 1681 1698 1699 1704 1705 1782 1788 1978 1982 2080 2081 2082 2088 2339

flap 1415 1677 1598 1683 1772 1792

flexibility 1783 1968 2321

flight 1311 1436 1574 1578 1606 1792 1968 1983 2101 2102 2104 2157 2379

flow 1311 1316 1317 1320 1321 1324 1335 1351 1360 1378 1383 1406 1409 1415 1420 1437 1443 1467 1476 1569 1572 1574 1575 1576 1578 1588 1589 1590 1591 1592 1597 1598 1605 1606 1608 1655 1656 1666 1667 1670 1672 1675 1676 1680 1681 1682 1683 1687 1688 1691 1692 1693 1694 1695 1696 1697 1699 1700 1701 1702 1703 1704 1705 1706 1707 1708 1709 1710 1711 1712 1713 1748 1772 1779 1785 1792 1793 1794 1795 1797 flow cont. 1798 1799 1880 1916 1919 1920 1921 1963 1964 1965 1966 1967 1970 1971 1972 1973 1978 1980 1981 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 2002 2074 2075 2076 2078 2080 2081 2082 2083 2084 2085 2099 2100 2104 2111 2153 2354 2355 2157 2187 2274 2313 2317 2318 2319 2338 2339 2341 2342 2364 2367 2391

flutter 1594 1682 1701 1704 1874 1879 1880 2111 2338 2339 2341

force 1360 1443 1594 1596 1613 1615 1655 1671 1677 1688 1693 1694 1696 1697 1704 1709 1719 1788 1794 1798 1919 1921 1966 1967 1970 1972 1973 1974 1984 1985 1995 2001

form 1302 1415 1592 1688 2002 2061

forward 1311 1700 1717 1794 1797 1992 1995 2080

free 1576 1592 1594 1608 1667 1696 1728 1970 1972 1973 1991 1993 1994 1995 1997 2153 2322 2364 2391

function 1302 1576 1667 1699 1701 1704 1705 1706 1779 1963 1965 1982 1988 2080 2082 2084 2111 2339

fundamental

gas 1302 1317 1437 1574 1576 1578 1656 1672 1691 1695 1966 1967 1974 2061 2077 2111 2274 2313 2317 2319 2391 general 2342

gust 1698 1699 1701 1702 1706 1779

heat 1302 1378 1383 1899 1406 1436 1437 1509 1972 1575 1576 1606 1620 1655 1666 1667 1670 1691 1695 1787 1963 1974 1978 1980 1981 1982 1983 1997 2002 2061 2077 2099 2100 2101 2104 2319 2391

height 1615 1616 1617 1618 1622 1710 1799 1974

high 1302 1316 1378 1406 1416 1420 1572 1574 1576 1578 1615 1672 1703 1792 1798 1799 1967 1968 1991 2101 2111 2155 2157 2274 2313

homogeneous 1980 2322

hypersonic 1360 1406 1437 1569 1572 1574 1575 1576 1578 1605 1655 1656 1666 1667 1670 1688 1707 1708 1713 1971 1972 1978 1982 1983 1997 2002 2076 2157 2274 2316 2318 2319 2379 2391

incidence 1311 1316 1572 1605 1672 1675 1713 1793 1794 1796 1799 1800 1921 2075

incompressible 1324 1351 1699 1701 1705 1748 1779 1785 1787 1988 1989 1990 2078 2082 2322 2341

induced 1311 1415 1416 1569 1672 1676 1677 1681 1693 1694 1793 1794 1797 1798 1967 1970 2154 2187 influence 1572 1684 1798

interference 1409 1672 1688 1695 1696 1697 1709 1783 1795 1799 1800 1970 1971 1993 1995 1997 2074 2075 2153 2154 2155 2316

iterative 1916 2087 2088

jet 1320 1321 1409 1415 1416 1598 1672 1692 1693 1694 1695 1696 1697 1729 1772 1970 1971 1972 1973 1991 1992 1993 1994 1995 1997 2061 2101

kinetic 1302 2391

kink 2364

laminar 1320 1321 1351 1378 1406 1437 1572 1606 1710 1798 1920 1966 1967 1973 1982 2076 2100 2104 2274 2322 2364 2367

large 1509 1963 1988

law 1578

layer 1302 1311 1316 1320 1321 1324 1335 1378 1383 1406 1415 1416 1436 1437 1569 1572 1576 1606 1698 1620 1655 1667 1671 1672 1675 1696 1710 1785 1787 1788 1792 1793 1794 1796 1797 1798 1799 1964 1965 1972 1973 1974 1982 1992 2076 2080 2099 2100 2154 2155 2157 2187 2274 2313 2317 2319 2321 2322 2364 2367 2391 lift 1311 1316 1360 1443 1671 1672 1675 1676 1677 1682 1683 1688 1692 1693 1694 1698 1699 1700 1701 1702 1704 1705 1706 1707 1708 1709 1711 1712 1713 1719 1772 1779 1792 1794 1795 1796 1797 1799 1919 1920 1921 2111 2339 2342 2379

lifting 1415 1672 1676 1677 1680 1681 1708 1711 2077

line 1588 1590 1591 1672 1683 2084 2316 2318

linear 1367 1451 1677 1719 1836 1916 2076

linearized 1680 1681 1683 1920 1921 2111

located

low 1588 1666 1667 1670 1712 1779 1792 2080 2082 2084 2274 2313 2319

Lyapunov 1367

Mach 1311 1316 1360 1437 1467 1569 1572 1575 1590 1597 1605 1606 1608 1672 1681 1683 1692 1693 1694 1695 1696 1697 1701 1702 1708 1710 1713 1748 1779 1783 1792 1796 1797 1798 1799 1800 1970 1971 1972 1973 1992 1993 1994 1995 1997 2001 2002 2074 2075 2076 2077 2104 2153 2155 2157 2187 2274 2313 2319 2338 2339 2341 2364 2367 magnitude 2339

mass 1576 1590 1608 1672 1701 1874 1968 2061 2154 2317

measured

measurement 1443 1569 1572 1594 1597 1598 1605 1608 1620 1622 1671 1675 1697 1794 1965 1970 1973 1974 1983 2002 2101 2103 2150 2155 2313 2316 2318

measuring

medium 2111

methane 1691

method 1322 1367 1594 1613 1672 1677 1748 1782 1783 1788 1921 1963 1990 1997 2074 2077 2080 2087 2088 2318 2342 2367

mode 1317 1619 1656 1728 1729 1916 2111 2322 2339

model 1311 1443 1572 1574 1578 1597 1618 1672 1713 1783 1792 1793 1795 1797 1799 1800 1874 1879 1880 1972 1973 1991 2001 2077 2153 2155 2340 2341

motion 1451 1617 1618 1656 1604 1699 1700 1702 1705 1717 1719 1785 1786 1787 1798 1978 2081 2339 2379

mounted 2150

multistage 1588 1589

natural 1710 1728

nature

Navier 2181 2391

nitrogen 1574 1575 1576 2316

noncircular

nonviscous 1985 1987 1988 1989 1990

normal 1317 1360 1443 1655 1671 1688 1693 1694 1696 1697 1699 1728 1729 1970 1971 1972 2001 2083 2154

number 1302 1569 1576 1590 1606 1608 1666 1667 1670 1672 1683 1691 1710 1786 1963 1964 1965 1967 1971 1973 1990 1991 1992 1993 1994 1995 1997 2080 2082 2083 2084 2155 2338 2364 2367

one 1590 1667

onset 1311 1316 1415 1416 1675 1719

orbit 1613 1614 1615 1616 1617 1618 1619 1621 1622 1968

order 1572 2075

oscillating 1597 1699 1700 1703 1704 1705 1916 1919 2084 2111

paper

parameter 1597 1671 1748 1880 1988 2077

particular

periodic 1451 1703

planform 1675 1677 1704 1711 1783 1792 1794 2341 point 1324 1436 1437 1476 1509 1590 1596 1666 1670 1672 1677 1717 1800 1978 1981 1983 1988 1989 1992 2082 2099 2104 2187 2274 2319 2342 2391

pressure 1311 1316 1317 1321 1335 1360 1383 1406 1409 1415 1416 1420 1436 1467 1569 1572 1574 1575 1588 1589 1590 1594 1605 1615 1655 1656 1671 1672 1675 1680 1681 1687 1688 1691 1692 1693 1694 1695 1696 1697 1703 1704 1709 1710 1728 1729 1772 1783 1794 1795 1798 1800 1919 1921 1964 1966 1967 1970 1971 1972 1973 1974 1983 1984 1985 1986 1988 1991 1992 1993 1994 1995 1997 2001 2002 2074 2075 2076 2078 2080 2081 2082 2083 2084 2103 2111 2153 2155 2157 2187 2274 2313 2318 2319 2321 2342 2364 2367

problem 1320 1321 1322 1351 1787 1792 2087 2088

product 1691

programmed

pump 1988 1989

quasiconical 1680 1681

ratio 1420 1576 1588 1589 1590 1597 1672 1691 1692 1693 1694 1695 1696 1698 1699 1703 1704 1708 1709 1711 1712 ratio cont. 1713 1748 1779 1782 1792 1793 1794 1799 1800 1879 1916 1919 1920 1964 1965 1968 1970 1971 1972 1973 1974 1986 1988 1993 1997 2077 2100 2111 2187 2318 2322 2338 2339 2340 2341 2342 2379

rectangular 1443 1672 1681 1699 1704 1712 1779 1782 1919 2342

reference 2111

regime 1667 2187 2391

report

response 1700 1729 1779 2321

result 1360 1670 2077 2100 2150 2153 2340

reynolds 1351 1420 1576 1606 1666 1667 1670 1709 1710 1712 1798 1964 1968 1971 1991 1992 1993 2078 2080 2081 2082 2083 2084 2085 2313 2364 2367

running 2313

satellite 1613 1614 1615 1616 1617 1618 1619 1620 1621 1622 1983 2150 2157

scale 1311 1416 1616 1622 1675 1798

second 1367 2075

separation 1311 1316 1335 1415 1416 1420 1598 1675 1683 1696 1792 1793 1794 1797 1798 1799 1972 1973 1974 1984 1986 2002 2080 2084 2187 2364 2367 shock 1311 1316 1317 1324 1335 1415 1416 1437 1569 1572 1575 1576 1578 1656 1666 1667 1688 1692 1693 1694 1695 1793 1794 1797 1798 1800 1974 1983 1993 1995 1997 2074 2077 2157 2187 2274 2313 2316 2317 2318 2319 2364 2367 2391

short 1717

simulation 1598 1692 1693 1799 1997 2153 2274

single 1588 1589 1597 1729 2316

slender 1605 1606 1681 1683 1719 1792 1919 1921

solution 1320 1321 1322 1351 1383 1415 1467 1476 1572 1575 1614 1656 1672 1677 1684 1700 1704 1719 1785 1786 1787 1836 1916 1920 1965 1978 1981 1982 1983 1987 2074 2077 2078 2081 2082 2083 2084 2085 2087 2088 2187 2322 2391

speed 1302 1311 1316 1416 1436 1588 1590 1666 1672 1683 1699 1792 1795 1796 1797 1799 1800 1874 1879 1989 1990 2083 2084 2111 2338 2339 2341 2391

stability 1367 1451 1598 1675 1688 1708 1709 1711 1712 1713 1782 1792 1916 1994 2001 2321 2322 2379 stage 1588 1589 1590 1592

stagnation 1324 1436 1437 1509 1574 1575 1576 1656 1666 1667 1670 1688 1707 1717 1972 1973 1978 1981 1983 1988 1989 1992 2082 2099 2100 2101 2104 2157 2274 2318 2319 2391

stalling 1588 1590 1675

state 1451 1576 1783 2061

stokes 2181 2182 2391

straight 1672 1676 2313

stream 1320 1409 1576 1608 1696 1788 1970 1972 1973 1974 1985 1987 1991 1993 1994 1995 1997 2061 2080 2082 2084 2099 2100 2153 2187 2364

subsonic 1316 1671 1672 1675 1676 1677 1680 1681 1682 1683 1700 1701 1702 1704 1705 1710 1711 1712 1779 1782 1783 1793 1794 1798 1799 1921 1970 1987 1995 2155 2339

supersonic 1311 1316 1360 1378 1406 1409 1415 1574 1597 1606 1608 1672 1680 1681 1682 1683 1687 1691 1692 1693 1694 1695 1696 1697 1700 1708 1710 1779 1792 1793 1794 1798 1799 1880 1920 1921 1970 1971 1973 1974 1987 1991 1992 1993 1994 1995 1997 2061 2074 2075 2111 2187 2338 2339 2364 2367 2379 surface 1316 1406 1415 1420 1509 1572 1576 1605 1606 1655 1667 1675 1676 1677 1680 1681 1684 1688 1692 1693 1694 1695 1704 1748 1782 1793 1794 1797 1798 1800 1971 1972 1978 1980 1982 1984 1987 1988 1989 1990 1992 1997 2076 2077 2078 2083 2099 2100 2157 2313 2321 2322 2342 2367 2391

surge 1588 1589 1590 1986

sweptback 1311 1316 1416 1709 1711 1713 1782 1792 1793 1794 1797 2338 2341

tapered 1699 1793

temperature 1302 1317 1351 1378 1383 1406 1436 1509 1572 1574 1575 1576 1578 1590 1592 1606 1620 1656 1672 1691 1707 1836 1963 1966 1967 1978 1980 1981 1982 1986 2061 2100 2101 2103 2157 2274 2316 2318 2319 2367

test 1311 1335 1575 1590 1672 1692 1693 1694 1695 1708 1709 1711 1713 1772 1792 1793 1794 1795 1796 1797 1798 1799 1800 1836 1874 1879 1880 1972 1973 1991 1992 1993 1994 1995 2076 2100 2101 2102 2104 2111 2153 2154 2157 2317 2319 2338 2340 2341 2364 theoretical 1437 1572 1799 1981 1983 1984 1987 1989 1990 2075 2099 2313 2317 2367 2391

theory 1302 1317 1367 1399 1436 1443 1451 1467 1572 1597 1605 1667 1676 1677 1681 1682 1683 1687 1703 1706 1729 1787 1788 1919 1920 1921 1964 1967 1985 1997 2075 2081 2111 2153 2154 2313 2319 2321 2339 2341 2342 2391

thermodynamic 1302 1351 1691

threedimensional 1324 1655 1672 1700 1710 1786 1797 1916 1921 1987 2100 2339

threepoint 1320 1321 1322

time 1606 1615 1616 1622 1672 1728 1786 1797 1980 1981 2317

trailing 1311 1409 1415 1416 1675 1676 1772 1792 1798 1988 1989

transfer 1378 1383 1406 1436 1437 1509 1572 1575 1576 1655 1666 1667 1670 1963 1968 1978 1980 1983 2002 2099 2104 2319 2391

transition 1335 1588 1667 1671 1675 1710 1719 1793 1794 1796 1992 2080 2364

transonic 1335 1415 1420 1467 1682 1709 1793 1794 1795 1796 1797 1798 1799 1800 1879 1916 1919 1991 2153 2154 2338 2341

tumble

tumbling 1717 1719

tunnel 1311 1335 1416 1420 1443 1569 1572 1575 1594 1597 1598 1605 1608 1656 1671 1672 1675 1693 1695 1708 1709 1710 1711 1772 1783 1792 1793 1794 1795 1796 1797 1798 1799 1800 1874 1879 1880 1972 1973 1991 1992 1993 1994 1995 2001 2002 2074 2075 2076 2104 2111 2153 2154 2155 2157 2274 2313 2318 2319 2338 2341 2364

turbulent 1378 1406 1409 1420 1606 1608 1671 1675 1798 1972 1973 1974 2061 2100 2104 2364

twodimensional 1316 1321 1324 1409 1467 1597 1655 1672 1687 1696 1700 1701 1702 1710 1779 1797 1798 1799 1972 1987 1990 2061 2074 2076 2081 2083 2085 2100 2153 2155 2157 2274 2319 2341 2342

under

unsteady 1311 1588 1698 1699 1700 1779 1919 1921 2104

upwash 1680 1683

use

vehicle 1436 1509 1598 1688 1707 1717 1968 1971 1972 1978 1982 1983 1994 1997 2001 2102 2111 2319 2379

viscosity 1302 1575 1671 1691 2082

viscous 1324 1351 1383 1572 1576 1578 1655 1667 1688 1786 1787 1788 1967 1992 2076 2078 2080 2081 2082 2083 2084 2322 2391

APPENDIX G

TABLES AND FIGURES

TABLE 1

DEPTH, BREADTH AND POSTING STATISTICS FOR DELETION OF TERM QUARTILES

DELETION	AVERAGE BREADTH	AVERAGE DEPTH	POSTINGS	DIFFERENT TERMS POSTED	AVERAGE BREADTH OF TERMS DELETED
No Deletion	2.17	34.49	6899	1370	
1st Quartile	1.63	25.87	5173	1337	52.12
2nd Quartile	1.63	25.86	5170	1285	20.34
3rd Quartile	1.63	25.88	5176	1147	7.72
4th Quartile	1.63	25.89	5178	341	1.72

TABLE 2

DELETION OF TERM QUARTILES: RECALL MEANS AND STANDARD ERRORS

CUTOFF	1		2		3		4		5	
DELETION	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
No	0.96	0.0139	0.83	0.0375	0.64	0.0497	0.43	0.0607	0.22	0.0480
1st Quartile	0.82	0.0326	0.52	0.0558	0.28	0.0512	0.16	0.0479	0.04	0.0198
2nd Quartile	0.87	0.0364	0.71	0.0538	0.44	0.0596	0.24	0.0503	0.08	0.0302
3rd Quartile	0.92	0.0285	0.72	0.0480	0.52	0.0608	0.31	0.0571	0.12	0.0388
4th Quartile	0.96	0.0105	0.82	0.0256	0.53	0.0395	0.32	0.0375	0.12	0.0274

Cutoff is the number of terms a document must have in common with a search question to be considered retrieved.

TABLE 3

DELETION OF TERM QUARTILES: PRECISION MEANS AND STANDARD ERRORS

CUTOFF	1		2		3		4		5	
DELETION	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
No	0.05	0.0077	0.17	0.0357	0.33	0.0536	0.48	0.0585	0.55	0.0829
1st Quartile	0.11	0.0141	0.36	0.0493	0.71	0.0568	0.90	0.0617	0.81	0.0931
2nd Quartile	0.08	0.0255	0.22	0.0429	0.36	0.0620	0.66	0.0876	0.66	0.1086
3rd Quartile	0.07	0.0234	0.18	0.0419	0.29	0.0551	0.42	0.0771	0.51	0.1066
4th Quartile	0.05	0.0080	0.17	0.0352	0.30	0.0566	0.44	0.0760	0.37	0.0479

Cutoff is the number of terms a document must have in common with a search question to be considered retrieved.

TABLE 4

DELETION OF TERM QUARTILES: PRECISION AND RECALL

CUTOFF	1		2		3		4		5	
DELETION	P	R	P	R	P	R	P	R	P	R
No	.05	.96	.17	.83	.33	.64	.48	.43	.55	.22
1st Quartile	.11**	.82**	.36**	.52**	.71**	.28**	.90	.16**	.81[x]	.04**
2nd Quartile	.08*	.87**	.22**	.71**	.36*	.44**	.66**	.24**	.66	.08**
3rd Quartile	.07	.92*	.18	.72**	.29	.52**	.42*	.31**	.51	.12**
4th Quartile	.05	.96	.17	.82	.30	.53**	.44	.32**	.37[x]	.12**

* Compared with no deletion the difference is significant at .05.

** Compared with no deletion the different is significant at .01.

x Sample size too small, owing to indeterminate changes in precision, to warrant any conclusion about significance.

Cutoff is the number of terms a document must have in common with a search question to be considered retrieved.

TABLE 5

STATISTICAL COMPARISON OF INDEXINGS OBTAINED BY DELETION OF TERM QUARTILES: RECALL

CUTOFF DELETIONS COMPARED	1	2	3	4	5
No vs. 1st	**	**	**	**	**
No vs. 2nd	**	**	**	**	**
No vs. 3rd	*	**	**	**	**
No vs. 4th			**	**	
1st vs. 2nd		*	**		
1st vs. 3rd	**	**	**	*	
1st vs. 4th	**	**	**	*	
2nd vs. 3rd					
2nd vs. 4th	**	**	*		
3rd vs. 4th		**			

* The difference is significant at .05.

** The difference is significant at .01.

Cutoff is the number of terms a document must have in common with a search question to be considered retrieved.

TABLE 6

STATISTICAL COMPARISON OF INDEXINGS OBTAINED BY DELETION OF TERM QUARTILES: PRECISION

CUTOFF DELETIONS COMPARED	1	2	3	4	5
No vs. 1st	**	**	**		x
No vs. 2nd	*	**	*	**	
No vs. 3rd				*	
No vs. 4th					x
1st vs. 2nd	**	*	**		
1st vs. 3rd	**	**			
1st vs. 4th	**	**	*		
2nd vs. 3rd					
2nd vs. 4th					
3rd vs. 4th					

* The difference is significant at .05.

** The difference is significant at .01.

x Sample size too small, owing to indeterminate changes in precision,to warrant any conclusion about significance.

Cutoff is the number of terms a document must have in common with a search question to be considered retrieved.

TABLE 7

DELETION OF TERM QUARTILES: ESL MEANS AND STANDARD ERRORS

S*	1		2		3		4		5	
DELETION	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
No	3.11	0.9804	11.76	3.5116	16.71	4.7759	35.24	8.3123	42.48	10.1508
1st Quartile	2.43	0.5286	10.67	2.8758	21.82	6.1846	47.89	9.2805	66.62	13.2676
2nd Quartile	7.58	2.9149	21.12	5.5695	28.60	6.4860	47.68	9.6960	48.38	10.0334
3rd Quartile	4.57	1.2244	16.64	4.0918	22.95	5.4234	43.56	8.7456	58.46	10.5611
4th Quartile	5.28	1.8888	12.04	3.3463	16.99	4.6077	37.86	8.3724	45.76	10.2191

S* is the number of relevant documents requested of the system.

TABLE 8

DELETION OF TERM QUARTILES: ESL

S* DELETION	1	2	3	4	5	AVG.
No	3.11	11.76	16.71	35.24	42.48	21.86
1st Quartile	2.43	10.67	21.82	47.89	66.62*	29.89
2nd Quartile	7.58*	21.12**	28.60**	47.68	48.38	30.67
3rd Quartile	4.57	16.64*	22.95	43.56	58.46*	29.23
4th Quartile	5.28*	12.04	16.99	37.86	45.76	23.59

* Compared with no deletion the difference is significant at .05.

** Compared with no deletion the difference is significant at .01.

S* is the number of relevant documents requested of the system.

TABLE 9

STATISTICAL COMPARISON OF INDEXINGS OBTAINED BY DELETION OF TERM QUARTILES: ESL

S*	1	2	3	4	5
DELETIONS COMPARED					
No vs. 1st					*
No vs. 2nd	*	**	**		
No vs. 3rd		*			*
No vs. 4th	*				
1st vs. 2nd	*	**			
1st vs. 3rd		*			
1st vs. 4th					*
2nd vs. 3rd					
2nd vs. 4th		**	*		
3rd vs. 4th					*

* The difference is significant at .05.

** The difference is significant at .01.

Cutoff is the number of terms a document must have in common with a search question to be considered retrieved.

TABLE 10

DEPTH, BREADTH AND POSTING STATISTICS FOR DELETION OF NON-TITLE, NON-WEIGHTED-10 TERMS
(AND CORRESPONDING RANDOM DELETIONS)

DELETION	AVERAGE BREADTH	AVERAGE DEPTH	POSTINGS	DIFFERENT TERMS POSTED	AVERAGE BREADTH OF TERMS DELETED
No Deletion	2.17	34.49	6899	1370	
Non-Title	.45	7.06	1411	427	5.82
Random	.45	7.07	1414	566	6.82
Non-Weighted-10	.47	7.43	1484	545	6.49
Random	.47	7.41	1483	621	7.23

TABLE 11

DELETION OF NON-TITLE AND NON-WEIGHTED-10 TERMS
(AND CORRESPONDING RANDOM DELETIONS): RECALL MEANS AND STANDARD ERRORS

CUTOFF	1		2		3		4		5	
DELETION	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
Non-Title	0.79	0.0383	0.53	0.0561	0.26	0.0475	0.15	0.0434	0.07	0.0263
Random	0.48	0.0396	0.15	0.0366	0.03	0.0145	0.01	0.0070	0.00	0.0018
Non-Weighted-10	0.66	0.0554	0.36	0.0575	0.15	0.0459	0.07	0.0328	0.03	0.0225
Random	0.51	0.0449	0.19	0.0374	0.05	0.0220	0.02	0.0140	0.00	0.0070

Cutoff is the number of terms a document must have in common with a search question to be considered retrieved.

TABLE 12

DELETION OF NON-TITLE AND NON-WEIGHTED-10 TERMS
(AND CORRESPONDING RANDOM DELETIONS): PRECISION MEANS AND STANDARD ERRORS

CUTOFF	1		2		3		4		5	
DELETION	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
Non-Title	0.11	0.0187	0.33	0.0648	0.65	0.0639	0.85	0.0506	0.86	0.0692
Random	0.09	0.0117	0.34	0.0589	0.42	0.0582	1.00	0.0000	1.00	0.0000
Non-Weighted-10	0.13	0.0169	0.49	0.0643	0.85	0.0660	0.95	0.0440	0.91	0.0599
Random	0.10	0.0178	0.38	0.0867	0.65	0.0779	1.00	0.0000	1.00	0.0000

Cutoff is the number of terms a document must have in common with a search question to be considered retrieved.

TABLE 13

DELETION OF NON-TITLE AND NON-WEIGHTED-10 TERMS (AND CORRESPONDING RANDOM DELETIONS): PRECISION AND RECALL

CUTOFF	1		2		3		4		5	
DELETION	P	R	P	R	P	R	P	R	P	R
No	.05	.96	.17	.83	.33	.64	.48	.43	.55	.22
Non-Title	.11** }**	.79** }**	.33**	.53** }**	.65** }*	.26** }**	.85**	.15** }**	.86*	.07** }**
Random	.09	.48**	.34**	.15**	.42**	.03**	1.00^x	.01**	1.00^x	.00**
Non-Weighted-10	.13** }*	.66** }*	.49**	.36** }**	.85**	.15** }*	.95^x	.07**	.91^x	.03**
Random	.10**	.51**	.38**	.19**	.65*	.05**	1.00^x	.02**	1.00^x	.00**

* Significant at .05.

** Significant at .01.

x Sample size too small to warrant any conclusion about significance.

A bracket around two values indicates that they are significantly different from each other.

Cutoff is the number of terms a document must have in common with a search question to be considered retrieved.

TABLE 14

DELETION OF NON-TITLE AND NON-WEIGHTED-10 TERMS
(AND CORRESPONDING RANDOM DELETIONS): ESL MEANS AND STANDARD ERRORS

S*	1		2		3		4		5	
DELETION	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
Non-Title	4.21	1.4724	11.60	2.9720	27.10	6.7941	50.69	9.3241	67.40	12.3842
Random	14.22	3.9318	42.69	7.2501	57.11	7.3318	89.40	9.2833	105.98	9.5332
Non-Weighted-10	8.92	2.8167	24.47	5.6094	42.13	7.7877	64.79	10.2693	79.11	13.4131
Random	12.63	3.3927	38.59	6.9107	58.88	7.9756	89.77	9.6906	94.24	11.8622

S* is the number of relevant documents requested of the system.

TABLE 15

DELETION OF NON-TITLE AND NON-WEIGHTED-10 TERMS
(AND CORRESPONDING RANDOM DELETIONS): ESL

S* DELETION	1		2		3		4		5	
No	3.11		11.76		16.71		35.24		42.48	
Non-Title	4.21	}**	11.60	}**	27.10	}**	50.69*	}**	67.40**	}**
Random	14.22**		42.69**		57.11**		89.40**		105.98**	
Non-Weighted-10	8.92*		24.47*	}*	42.13**	}*	64.79**	}*	79.11**	
Random	12.63**		38.59**		58.88**		89.77**		94.24**	

* Significant at .05.

** Significant at .01.

A bracket around two values indicates that they are significantly different from each other.

S* is the number of relevant documents requested of the system.

Number of Overlaps	Document Retrieved					
6	1666*	1670*	2100	2319		
5	1436	1509	1575	1576	1667*	1978
4	1302	1437	1572	1981	1983	2082
3	1324*	1378*	1383	1496	1590	1606
	1655	1656	1672	1691	1963	1980
	1988	1989	2101			
2	1360	1574	1578	1588	1596	1620
	1671	1707	1717	1787	1836	1972
	1973	1974	1982	1992	1997	2002
	2061	2077	2080	2071	2083	2153
	2157	2318				
1	1311	1316	1351	1399	1420	1476
	1589	1592	1675	1677	1680	1688
	1695	1701	1783	1792	1798	1799
	1800	1916	1965	1966	1968	1971
	1984	1986	2001	2078	2084	2088
	2102	2103	2150	5187	2316	2317
	2339	2340	2342	2367		

FIG. 1

DOCUMENTS RETRIEVED IN RESPONSE TO QUESTION 118

The documents are ordered according to overlap level.
Documents relevant to the question are marked with a star (*).

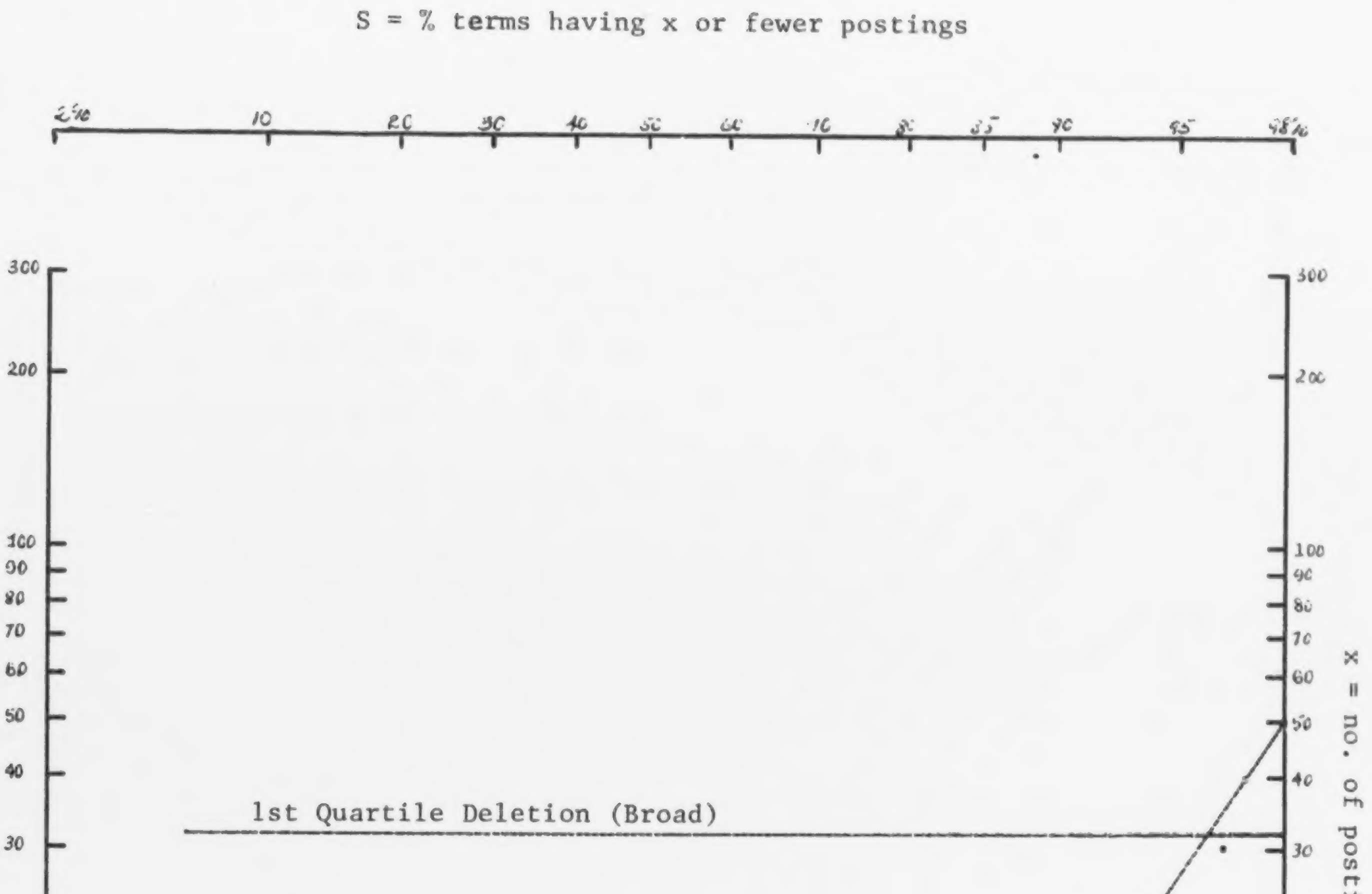


FIG. 2

DISTRIBUTION OF INDEX TERM USAGE

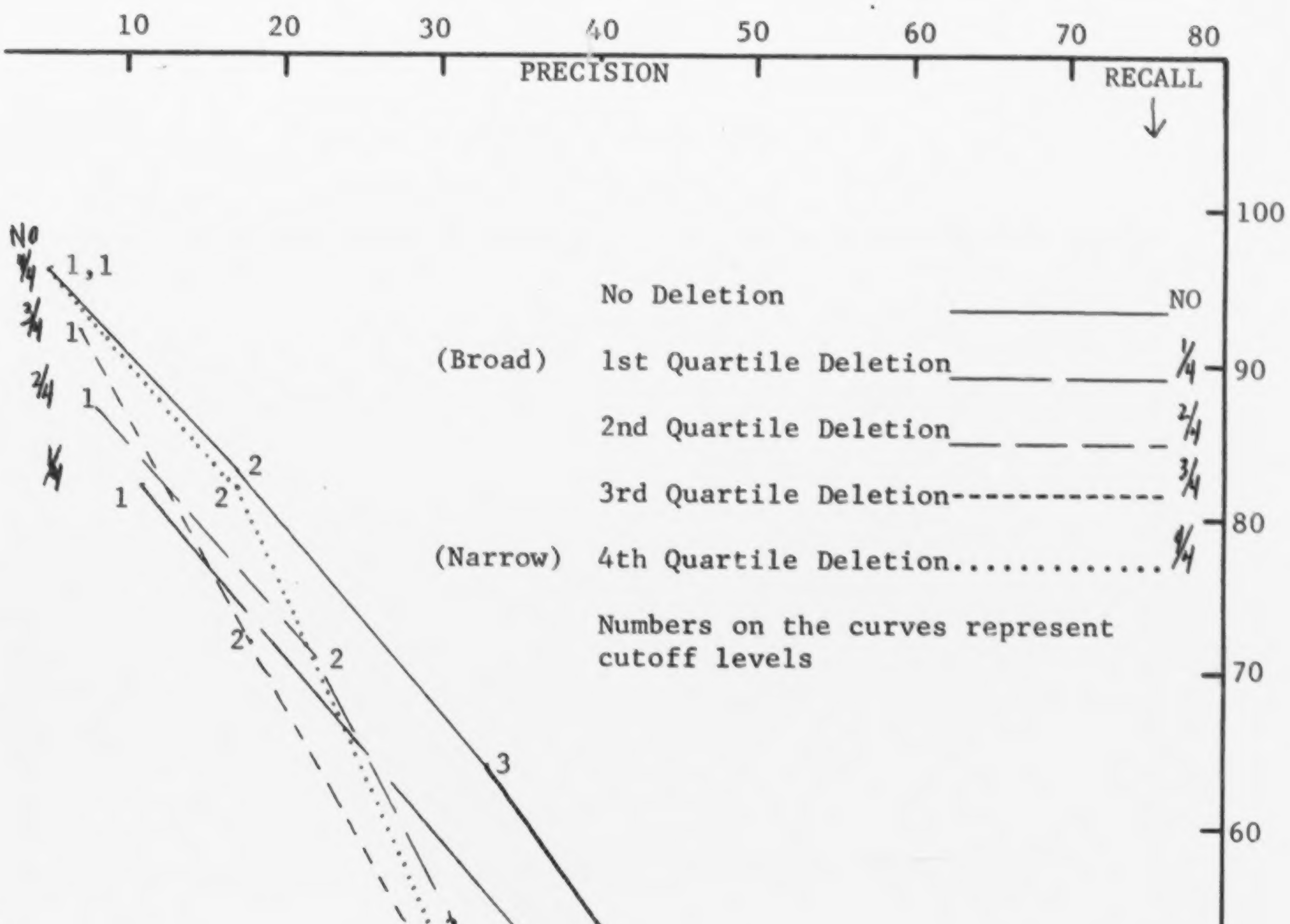
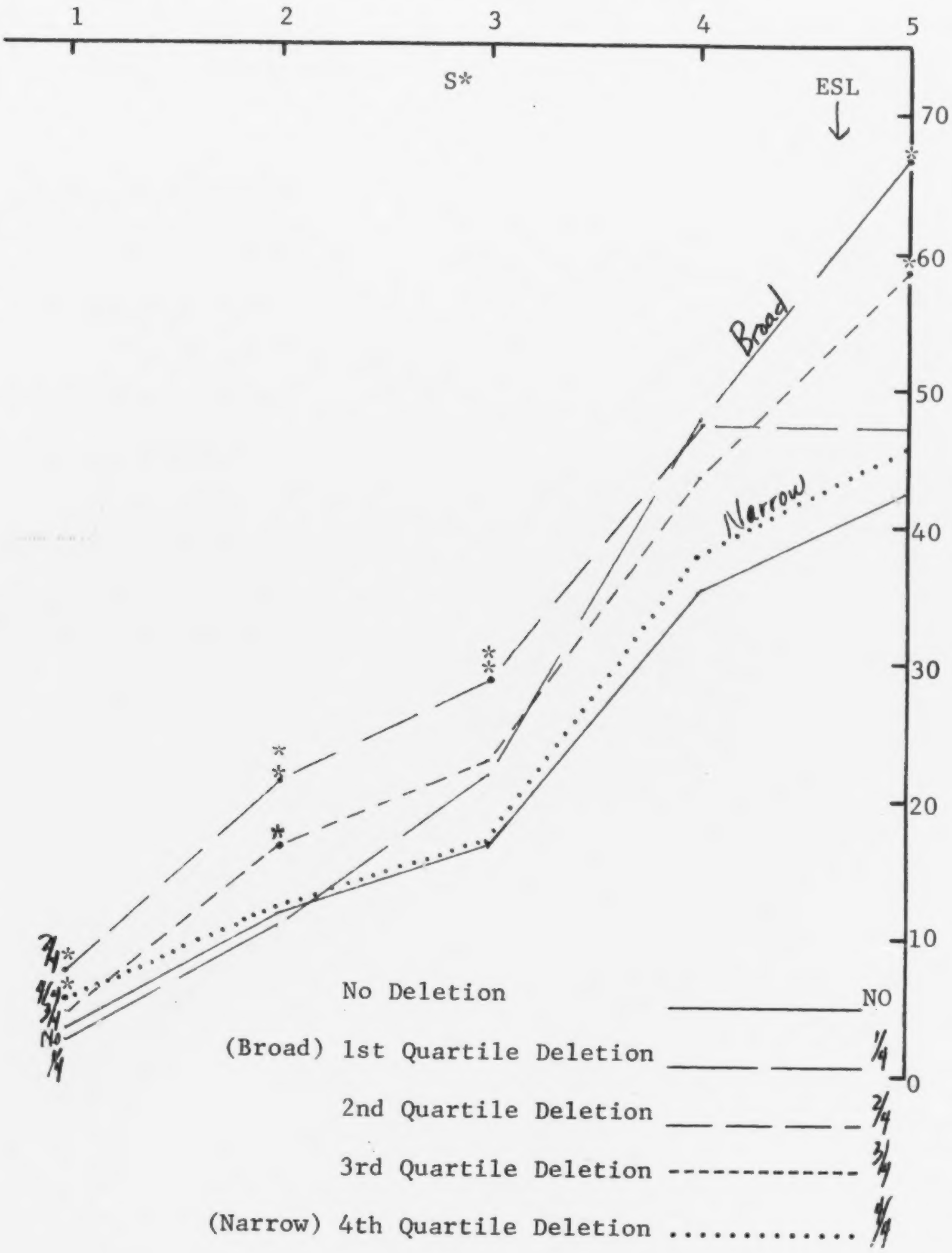


FIG. 3

DELETION OF TERM QUARTILES: PRECISION AND RECALL



* Compared with no deletion the difference is significant at .05

** Compared with no deletion the difference is significant at .01

FIG. 4
DELETION OF TERM QUARTILES: ESL

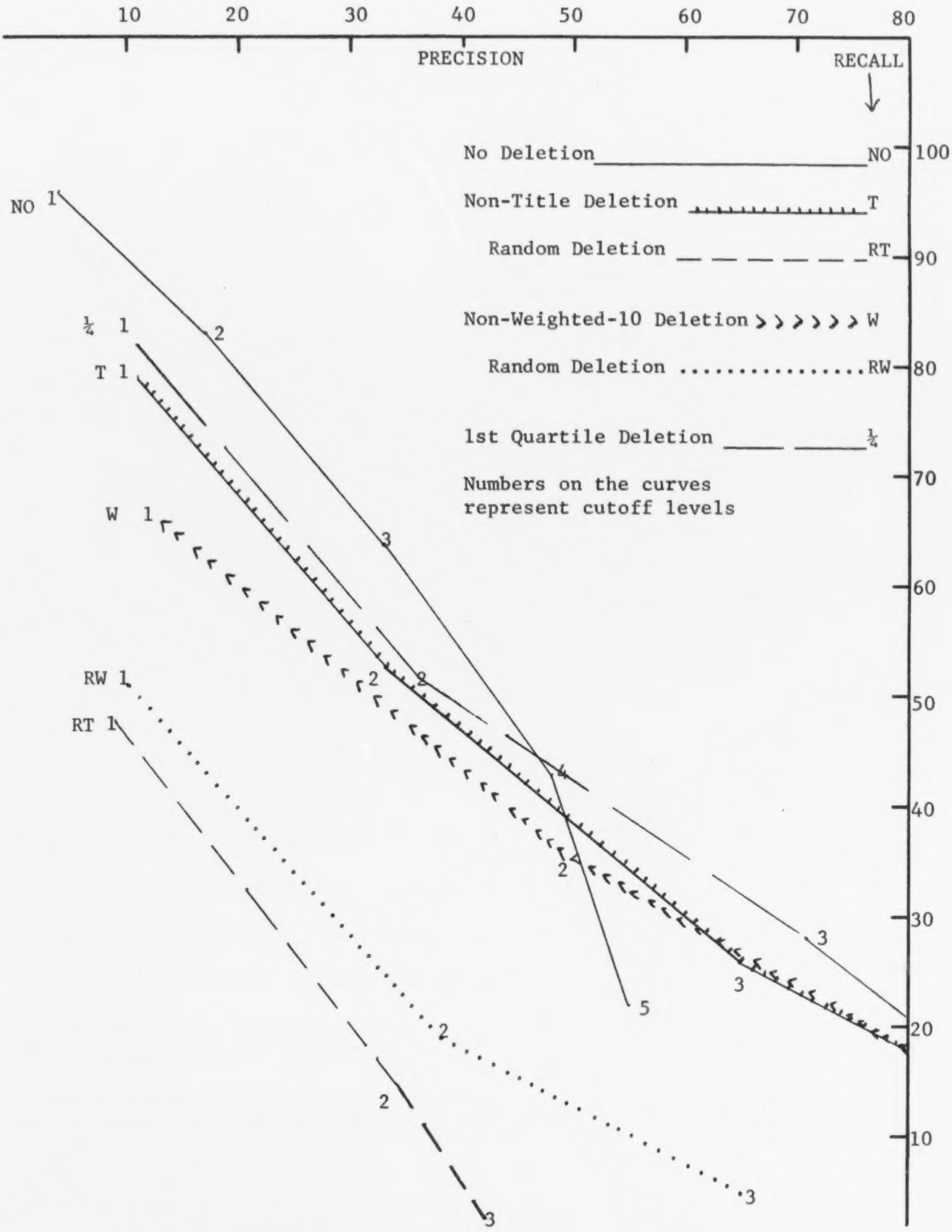
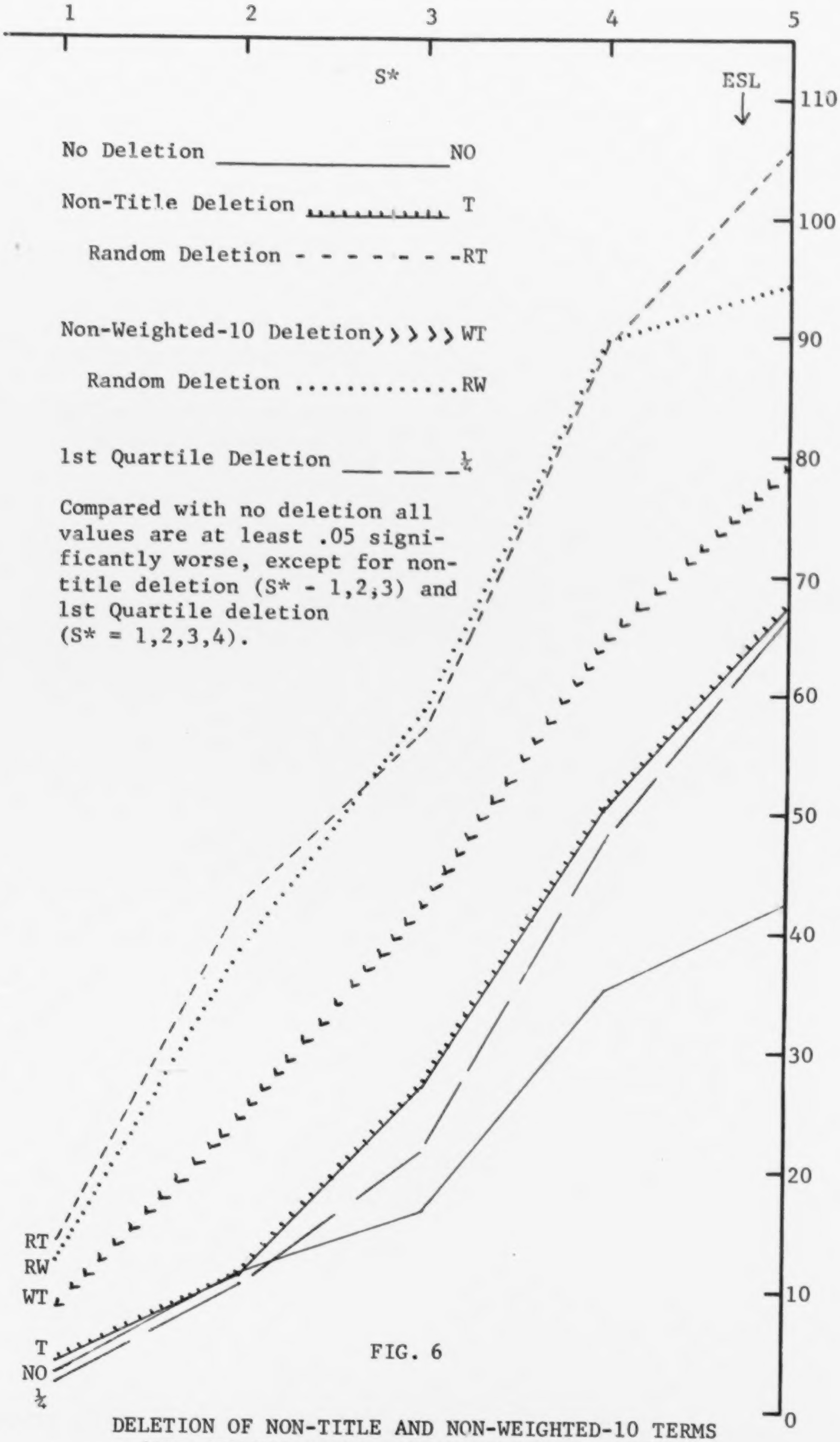


FIG. 5

DELETION OF NON-TITLE AND NON-WEIGHTED-10 TERMS
(AND CORRESPONDING RANDOM DELETIONS): PRECISION AND RECALL



Compared with no deletion all values are at least .05 significantly worse, except for non-title deletion (S* - 1,2,3) and 1st Quartile deletion (S* = 1,2,3,4).

FIG. 6

DELETION OF NON-TITLE AND NON-WEIGHTED-10 TERMS
(AND CORRESPONDING RANDOM DELETION): ESL

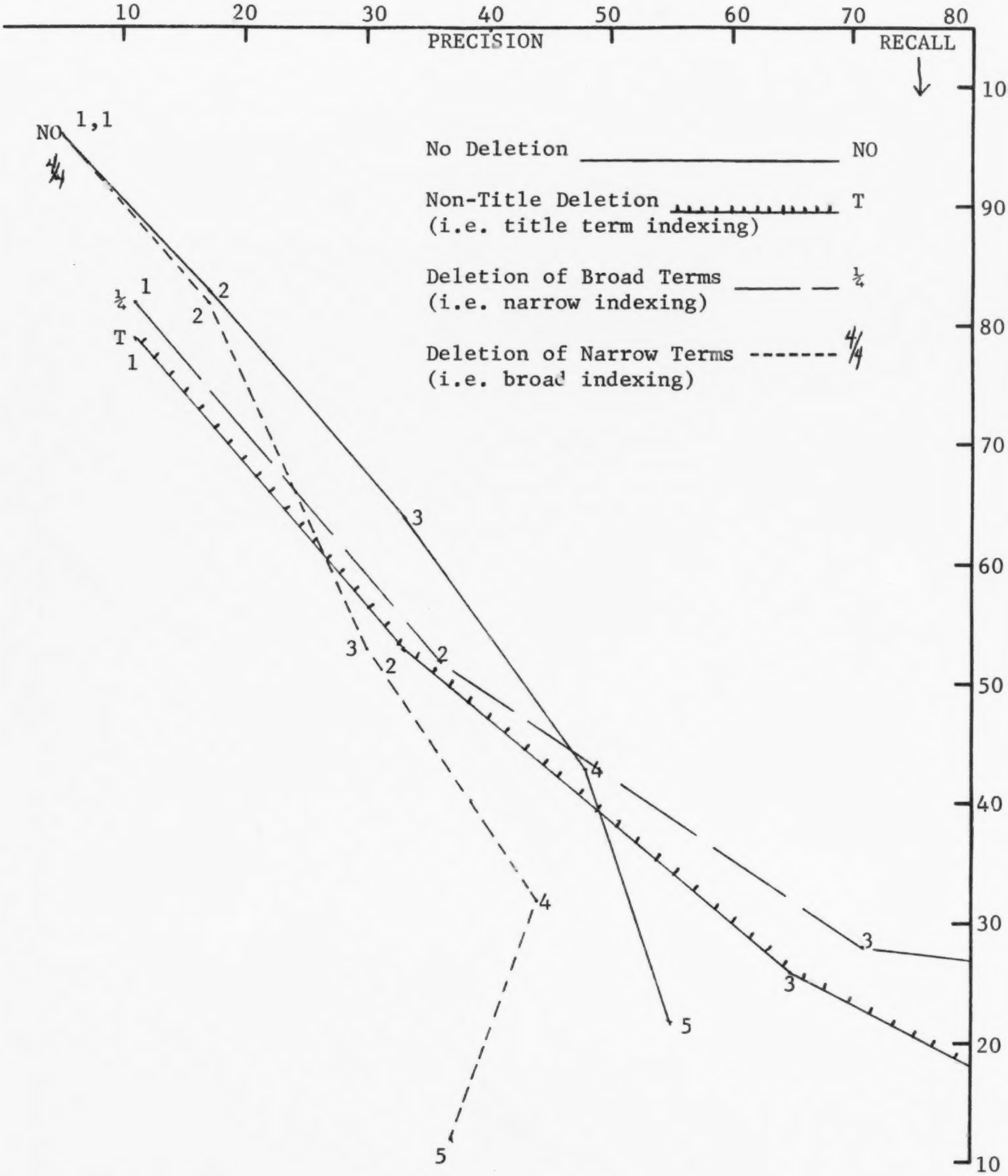


FIG. 7

DELETION OF BROAD, NARROW AND NON-TITLE TERMS:
PRECISION AND RECALL

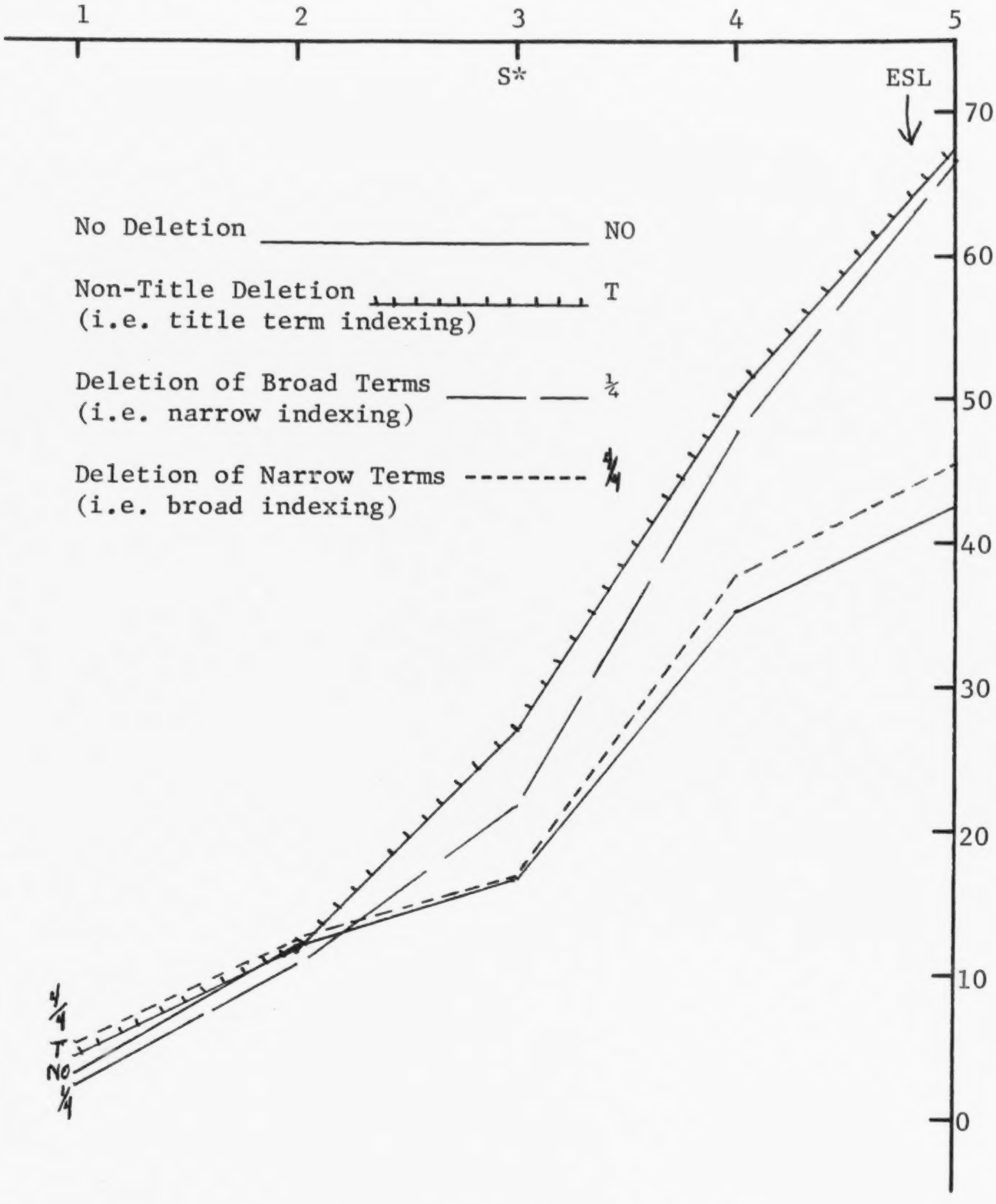


FIG. 8

DELETION OF BROAD, NARROW AND NON-TITLE TERMS: ESL